

Eps8 is a potential anticancer drug target in colorectal cancer

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M.-C. Maa, J.-C. Lee, Y.-J. Chen, Y.-J. Chen, Y.-C. Lee, S.-T. Wang, C.-C. Huang, N.-H. Chow, and T.-H. Leu (2007) Eps8 facilitates cellular growth and motility of colon cancer cells by increasing the expression and activity of focal adhesion kinase. *J. Biol. Chem.* 282,19399-19409

Eps8 (EGF receptor pathway substrate number 8) is an adaptor protein and a common substrate for both EGF receptor and Src tyrosine kinase. Src not only can phosphorylate Eps8 but also influence its expression. Overexpression of Eps8 in murine fibroblasts led to cellular transformation, and remarkably, upregulation of Eps8 played a pivotal role in Src-mediated carcinogenesis. Of note, Eps8 is also an actin capper that can regulate Rac activation and actin-based mobility.



Colorectal cancer (CRC) is one of the ten leading cancers and one of the major causes of cancer mortality regardless of sex difference worldwide. Elevated expression and/or activity of Src and its substrate, focal adhesion kinase (FAK), are reported to associate with the progression of colorectal adenoma to invasive carcinoma. Despite the role of Eps8 in mitogenesis and migration is well established, its contribution to human neoplasm is still unclear. To address this issue, plasmids expressing nonspecific siRNA or *eps8*-specific siRNA were introduced into SW620 and WiDr cells to obtain the corresponding control and Eps8-attenuated cells. Eps8 diminishment resulted in reduced proliferation, colony formation in soft agar and promotion of xenografting tumor growth in colon cancer cells. Interestingly, reintroduction of Eps8 rescued these defects. Eps8 attenuation decreased Src Pi-Tyr-416, Shc-Pi-Tyr-317, and serum-evoked FAK Pi-Tyr-397 and Pi-Tyr-861. Astonishingly, Eps8 could increase the expression of FAK by mTOR/STAT3 Pi-Ser-727. Due to forced expression of FAK in Eps8 knockdown cells restored cellular growth and mobility, we concluded that Eps8-induced proliferation and locomotion was partly attributable to FAK.

Consistent with the importance of Eps8 in both cell proliferation and motility in colonocytes, preferentially augmented Eps8 in the advanced stage of human CRC was observed. In agreement with Eps8-elicited FAK expression, the concomitant enhancement of FAK and Eps8 was detected in tumor specimen. Since Src can increase the expression of Eps8, which in turn could up-regulate FAK, a previously unidentified hierarchy of mutual regulation among Eps8, Src, and FAK contribution to the formation of human CRC could be postulated in Figure 1. In this model, Eps8 overexpression augments not only the expression of FAK and cyclin D1 via mTOR/STAT3 pathway but also promotes activation of Src and FAK. Meanwhile, Src retains the ability to enhance Eps8 expression, which in turn further provokes the expression and activity of FAK required for colonocyte proliferation and migration. These events accelerate disease progression of colon cancer. Given all these evidences, the involvement of

Eps8 in colon tumor formation and progression is confirmed. Since downregulation of Eps8 reduces mitogenesis and mobility of colon cancer cells, searching for agents with Eps8 attenuation activity might open a totally novel avenue for colon cancer treatment.

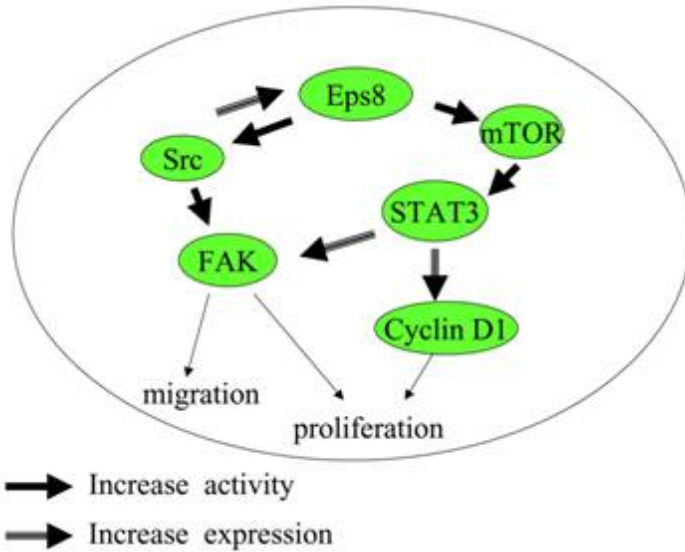


Figure 1. Model of Eps8, Src, and FAK in the progression of colon cancer (adapted from J. Bio. Chem. 282, 19399-19409, 2007).

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Entecavir Therapy for up to 96 Weeks in Patients With HBeAg-Positive Chronic Hepatitis B

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Introduction:

Chronic hepatitis B (CHB) is one of the most common infectious diseases in Taiwan, affecting approximately three million people. More than one-half of reported cases of hepatocellular carcinoma (HCC) and reported cases of cirrhosis are caused by chronic hepatitis B. An estimated 400 million people worldwide are chronically infected with hepatitis B virus (HBV). HCC and cirrhosis, in turn, result in approximately one million deaths each year. A goal of treatment for CHB is to suppress HBV replication, thus decreasing the hepatic necroinflammatory response and arresting or reversing progression of liver disease. Entecavir is a potent inhibitor of HBV DNA polymerase. Entecavir demonstrated superior histologic, virologic, and biochemical responses to lamivudine at 48 weeks in nucleoside-naïve patients with hepatitis B e antigen (HBeAg)-positive chronic hepatitis B. The efficacy and safety of entecavir in HBeAg-positive patients was evaluated in a large randomized international clinical trial. The present analysis investigates the efficacy and cumulative safety of entecavir versus lamivudine for up to 96 weeks of blinded treatment.



Methods:

The efficacy and safety of entecavir in patients with HBeAg-positive chronic hepatitis B were established in a double-blind, international study in which patients were randomized to entecavir 0.5 mg/day or lamivudine 100 mg/day. 709 HBeAg-positive CHB patients were randomized to entecavir 0.5 mg (n = 354) or lamivudine 100 mg (n = 355) once daily. At week 52, protocol defined virologic responders could continue blinded treatment for up to 96 weeks. Patients continuing in year 2 (entecavir, n = 243; lamivudine, n = 164) were assessed for serum hepatitis B virus (HBV) DNA, alanine aminotransferase (ALT) normalization, HBeAg seroconversion, and safety. Cumulative confirmed proportions of all treated patients who achieved these responses were also analyzed.

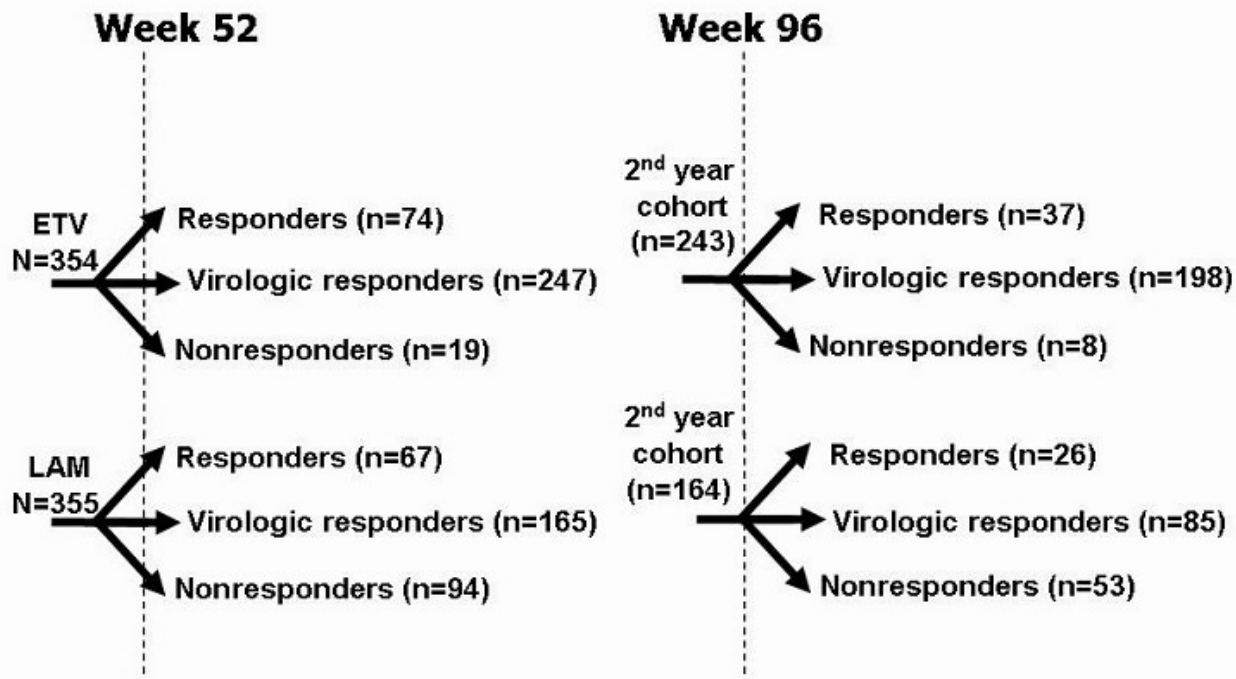


Figure 1. Management of patients through 96 weeks of treatment. Fourteen entecavir recipients and 29 lamivudine recipients had missing 48 week data.

Results:

Among the 243 entecavir and 164 lamivudine virologic responders (HBV DNA <0.7 MEq/mL but no loss of HBeAg) who continued treatment into a second year, 74% and 37% respectively, achieved a serum HBV DNA <300 copies/mL, and 79% and 68% respectively, normalized ALT levels at end of dosing in year 2. Similar proportions of entecavir-treated and lamivudine-treated patients achieved HBeAg seroconversion (11% vs 12%, respectively).

A significantly higher percentage of entecavir-treated patients than lamivudine-treated patients achieved cumulative confirmed HBV DNA <300 copies/mL (80% vs. 39%, respectively, $p < 0.0001$), and cumulative confirmed normalization of ALT (87% vs. 79%, respectively, $p < 0.0056$). The proportion of patients experiencing HBeAg seroconversion (31% vs. 25%, respectively), HBsAg loss (5% vs. 3%, respectively) and HBsAg seroconversion (2% in both groups) did not differ significantly between the two treatment groups. Through 96 weeks, no patient experienced virologic breakthrough due to entecavir resistance. The safety profile was comparable in both groups.

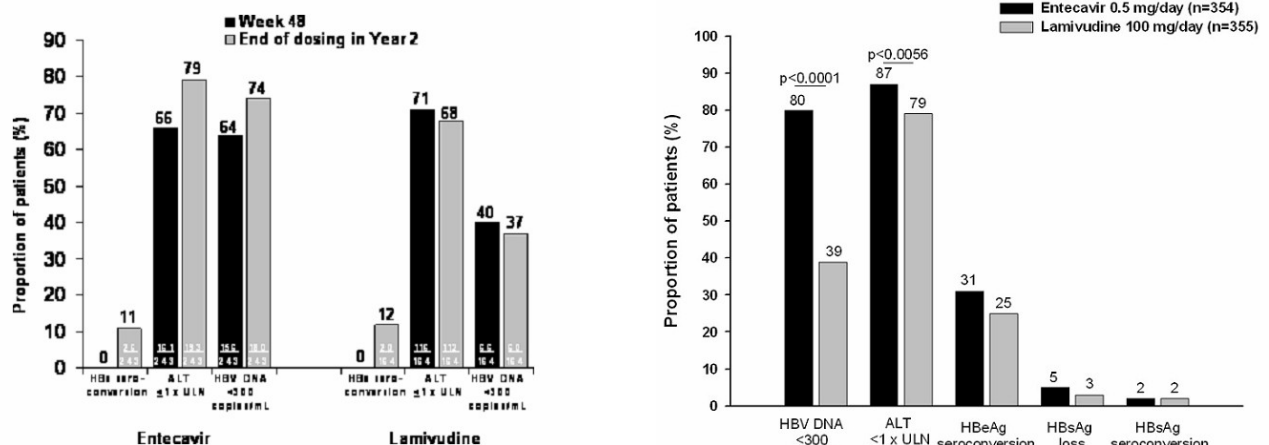


Figure 2. Outcomes in patients with a ‘virologic response’ at 48 weeks (HBV DNA <0.7 MEq/mL without loss of HBeAg) who continued treatment in year 2.

Figure 3. Cumulative confirmed proportions of all-treated patients who achieved undetectable HBV DNA (<300 copies/mL), normalization of serum ALT or a serologic end point through 96 weeks of treatment.

Discussion:

The cumulative confirmed results of this study show that extended treatment with entecavir provided continued viral suppression and normalization of ALT levels through 96 weeks. In contrast, the proportions of lamivudine-treated patients achieving these end points decreased over the course of the study. Continued monitoring for resistance in year 2 among those with detectable HBV DNA levels or virologic breakthrough confirmed that entecavir resistance through 96 weeks is rare. Over this 2-year experience, entecavir maintained a safety and tolerability profile that was comparable to that for lamivudine. Nonetheless, discontinuation of treatment among patients who achieved a protocol-defined response at 48 weeks resulted in more than 77% of entecavir-treated patients sustaining HBe seroconversion for 6 months off-treatment. Given the maintained suppression and low rates of resistance with prolonged therapy, entecavir represents an important advance in the management of CHB in nucleoside-naïve HBeAg-positive patients.

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A novel heterodyne polarimeter for the multiple-parameter measurements of twisted nematic liquid crystal cell using a genetic algorithm approach

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1. Introduction

The optical parameters such as a cell gap, twist angle, and the entrance orientation of molecular direction (i.e. the director angle) are highly important for twisted nematic liquid crystal (TNLC) displays because these parameters are closely related to the optical qualities of the LC display devices. In this article, a new approach for the multiple-parameter measurements of the TNLC cell is developed.

Different from the above studies, we propose to use a genetic algorithm for the analysis of the intensity ratio and the phase of detected heterodyne signal from a novel heterodyne polarimeter for measurements through solving inverse problem. Genetic or evolutionary algorithms have been used in recent years as a powerful technique for solving optimization and fitting problems. Their ability to avoid local minima by following many search paths simultaneously makes genetic algorithms a very interesting choice for solving multi-parametric problems. Genetic algorithms do not require a starting point and in general have a greater range of convergence than other inversion techniques. They are readily adaptable to many different problems and also have low computation times. They also do not require the evaluation of derivatives, instead relying on a merit function to improve performance. The experimental results confirm the ability of the proposed heterodyne polarimeter with genetic algorithm to determine the azimuth angle of the entrance LC director α , the twist angle ϕ , and the cell gap d . The proposed study has the advantages of reducing the perturbation of the environment and improving the signal-to-noise ratio (SNR) of the detected signal in the scheme of heterodyne polarimeter.



2. Principles of Operation

Fig. 1 presents a schematic diagram of the measurement system utilized to measure three parameters from a TNLC cell. As shown, the polarization modulator comprises two quarter-wave plates and an EO modulator. The EO modulator placed between two orthogonal quarter-wave plates (QWP) whose slow axes form an angle of $\pm 45^\circ$ with that of the EO modulator. The EO modulator is driven by a saw-tooth waveform signal with angular frequency ω supplied by a function generator. A He-Ne laser was employed as the light source and two Glan-Thompson polarizers served as the polarizer and the analyzer

respectively. The TNLC cell is placed between the polarization modulator and the analyzer.

Having passed through the TNLC cell and the analyzer, the electric field in the polarized laser beam can be expressed as

$$\vec{E} = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{bmatrix} \begin{bmatrix} \cos \phi & -\sin \phi \\ \sin \phi & \cos \phi \end{bmatrix} \begin{bmatrix} \cos X - i \cdot \Gamma \cdot \frac{\sin X}{2X} & \phi \cdot \frac{\sin X}{X} \\ -\phi \cdot \frac{\sin X}{X} & \cos X + i \cdot \Gamma \cdot \frac{\sin X}{2X} \end{bmatrix} \begin{bmatrix} \cos \alpha & \sin \alpha \\ -\sin \alpha & \cos \alpha \end{bmatrix} \begin{bmatrix} \cos(\frac{\omega t}{2}) & \sin(\frac{\omega t}{2}) \\ -\sin(\frac{\omega t}{2}) & \cos(\frac{\omega t}{2}) \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix} \quad (1)$$

with

$$\begin{cases} X = \sqrt{\phi^2 + (\Gamma/2)^2} \\ \Gamma = 2\pi d \Delta n / \lambda \end{cases} \quad (2)$$

where α is the azimuth angle of the entrance LC director, ϕ is the twist angle of LC cell, Γ is the linear retardance of the LC cell, d is the cell gap, Δn is the linear birefringence of LC.

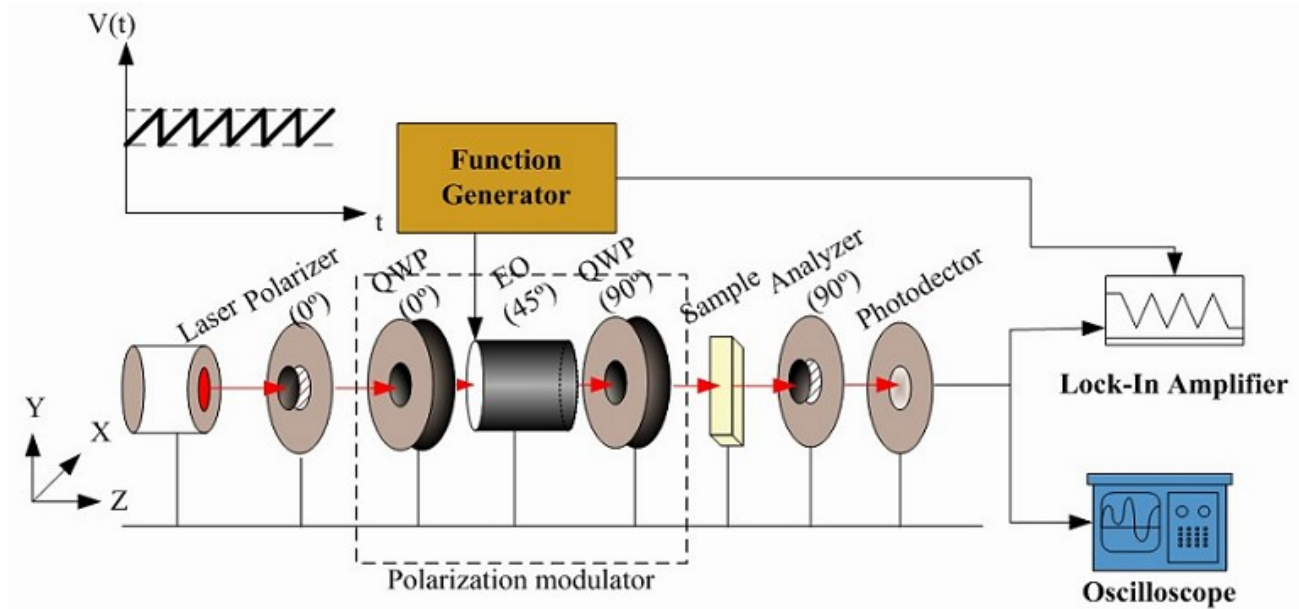


Figure 1 Schematic diagram of TNLC measurement system. QWP: quarter-wave plate; EO: electro-optic modulator; Sample: TNLC cell.

The output signal intensity from the photo-detector can be deliberately simplified as

$$I = I_{DC} + K \sin(\omega t + \sigma) \quad (3)$$

As a result, the detected heterodyne signal would be a sinusoidal signal with the same angular frequency of the driving voltage signal. As can be seen in Eq. (3), the final form of the detected signal consists of a DC term and a modulated term. In the mathematically simplifying process, the DC term, the amplitude and the phase of the sinusoidal term can be expressed as the functions of LC parameters (α, ϕ, d). The phase-lock method can be used to extract the phase $\sigma(\alpha, \phi, d)$ of the detected signal. The intensity ratio,

which is defined as $A_G(\alpha, \phi, d) \equiv K / I_{DC}$ in order to eliminate the influence of the perturbation and attenuation of intensity, is also acquired from the oscilloscope.

3. Genetic Algorithm Model for Extracting TNLC Parameters

The genetic algorithm is an iterative procedure that represents the candidate solutions as strings of genes referred to as chromosomes. The viability of these chromosomes is assessed via a fitness function, which represents a measure of the objective to be obtained. Three fundamental operators, namely selection, crossover, and mutation are involved in the genetic algorithm. In the present application, the most suitable TNLC parameters have a greater probability of surviving to the next operator. Within the genetic algorithm, an important process is that of mutation, which causes an existing individual to be modified, and hence introduces an additional variability into the population. This process is important since it can prevent the generation of a local optimal solution. In the mutation process, a species string is picked at random, a mutation point is randomly selected, and the bit information is then changed. The probability in the mutation process is controlled by the mutation probability.

The error function (fitness function) is a measurement of the distance between the computed A_G and σ and the experimental ones. In the current methodology, there are three sets of A_G and σ and each one is associated with three different azimuth angles of the TNLC sample cell. The error function in the present study can be defined as

$$\begin{aligned} \text{Error} &= E_{A_G} + E_{\sigma} \\ &= \left(0.5 \times \sum_{n=1}^3 (A_{G_n, \text{Exp}} - A_{G_n, \text{Comp}})^2 \right) + \left(0.5 \times \sum_{n=1}^3 (\sigma_{n, \text{Exp}} - \sigma_{n, \text{Comp}})^2 \right) \end{aligned} \quad (4)$$

where E_{A_G} is the error function of the intensity ratio, E_{σ} is the error function of the phase term of the detected signal, $A_{G_n, \text{Exp}}$ and $\sigma_{n, \text{Exp}}$ represent the experimental value of intensity ratio and phase respectively in three different azimuth angles of the same TNLC cell. Similarly, $A_{G_n, \text{Comp}}$ and $\sigma_{n, \text{Comp}}$ represent the intensity ratio and the phase computed from the Jones matrix method. The objective of the inverse problem is to inversely derive the parameters (α, ϕ, d) which yield A_G and σ most closely meet the experimental value. Fig.2 presents the major steps of the optimization algorithm.

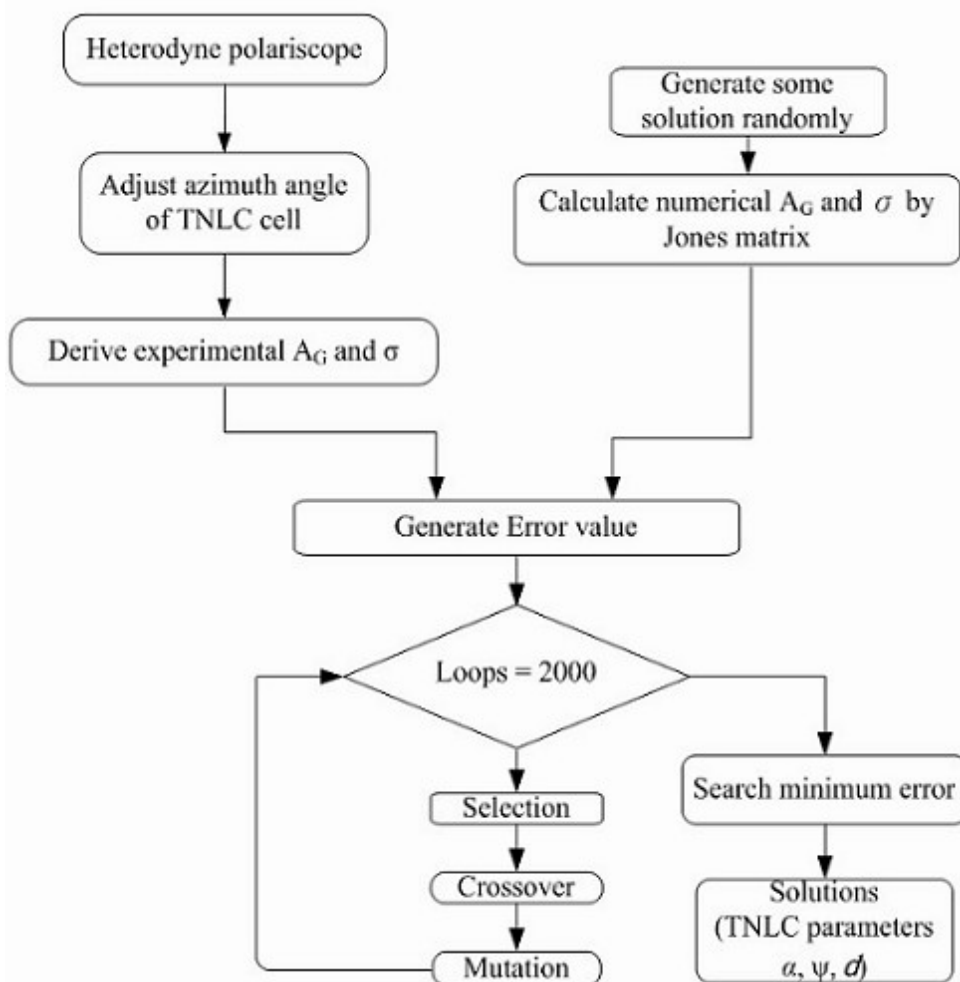


Figure 2 Flow chart of genetic algorithm.

4. Experimental Results

In the schematic diagram of Fig. 1, a TNLC test cell is used as sample in the measurement system. The TNLC cell is with 90 degree twist angle (ϕ), 4.2 micron cell gap (d), 3.4 degree pretilt angle, and the n_e and n_o of the LC are 1.569 and 1.483 respectively. The EO modulator (Conoptics, Model 370) was driven by a saw-tooth signal with 1k Hz frequency. Before the TNLC sample was placed into the experimental setup, the DC bias of EO modulator had to be adjusted to make the detected signal and driving signal in phase (i.e., $\sigma = 0$) for the elimination of the initial phase effect caused by EO modulator.

The experimental results of the TNLC test cell are illustrated in Table I. From Table I, the inversely calculated value of the parameters of the LC sample has good stability in different measurements. The calculated twist angle is about 90.18 degree, which is very close to the data given by manufacturers. However, the cell gap is about 4.12 μm which has a deviation about 0.1 μm compared to the value 4.2 μm provided by manufacturer. The average deviation in twist angle level of 0.01 $^\circ$ and that in director angle of 0.227 $^\circ$ are obtained.

Table I Experimental results

Measurement Number	Parameters for measurement	Calculated results
No.1	α (deg)	11.44 ± 0.09
	ϕ (deg)	90.18 ± 0.04
	d (μm)	4.109 ± 0.003
No.2	α (deg)	11.90 ± 0.01
	ϕ (deg)	90.17 ± 0.01
	d (μm)	4.135 ± 0.001
No.3	α (deg)	11.34 ± 0.03
	ϕ (deg)	90.20 ± 0.06
	d (μm)	4.101 ± 0.007
Average Data	α (deg)	11.56 ± 0.23
	ϕ (deg)	90.18 ± 0.01
	d (μm)	4.115 ± 0.013

5. Conclusions

This study proposes an intensity- and phase-sensitive heterodyne polarimeter in which the test TNLC cell is adjusted in three different azimuth angles for the detection of the heterodyne signal. The precision of this proposed method depends on how accurately the phase and the intensity ratio are measured. The system combines the features of optical heterodyne interferometry and genetic algorithm, which makes it possible to present a higher sensitivity of intensity and phase detections and simultaneous multi-parameter extraction in TNLC cells. The detected signal of the modulated light in the system can be simplified as a sinusoidal form (heterodyne signal), which is very suitable for the use of a phase lock-in technique. Furthermore, acquiring the intensity ratio instead of the amplitude can eliminate the intensity variation caused by the absorption of optical elements. In addition, the genetic algorithm is also ideally suited to the multiple-parameter synthesis problem addressed in the study. As a result, the new proposed approach provides a simple configuration and high stability method to measure TNLC parameters.

Judicial Independence and Democratic Accountability

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1. Introduction

There is a conflict between judicial independence and democratic accountability, but this problem is particularly serious for Taiwanese prosecutorial system. The judiciary and prosecution emphasized on institutional reform but ignored the problem of judicial democratic accountability. In order to understand the root of the problem, this paper first discusses how reform-minded judges used the Judicial Council to reform the judiciary, while reform-minded prosecutors used the Prosecutorial Council to reform the prosecutorial system. However, both of them ignored the importance of democratic accountability because of the poor quality of Taiwan's democracy. This paper offers a proposal in which some members of the Judicial Council should be politically appointed while some should be elected by judges and prosecutors to seek a balance between judicial independence and democratic accountability.



2. Judicial independence and democratic accountability

Society asks more accountability when there was an expansion of the judiciary. There is a conflict between judicial independence and democratic accountability (Cappelletti, 1985; Russell, 2001; Seidman, 1988; Shetreet, 1985). Judicial independent means judges could avoid some kinds of political accountability (Resnik, 2005: 589). However, what reason can ensure a judge would not abuse his power while he/she exercises authority? How does an independent judicial institution respond to social demands? What kind of supervision - as the question brought by Cappelletti (1985): "Who watches the watchmen?" - would not hinder the judicial independence? If we consider with judicial independence and democratic accountability, the appointment of judicial personnel is the important and core issue because not only it decides the legitimacy originated from judicial authority, but also it can influence the judicial direction (Peretti, 1999).

Unlike other countries, the judicial institution in Taiwan is extreme independence and lacking of democratic supervision: judges have lifetime appointments, and the process of appointment is very simple. The promotion and transference of position is almost not influenced by democracy politics. Judicial Council has no delegates from other political departments (executive and legislature). Actually, besides the Justices of Constitutional Court, any appointment of judge is not by democratic process in

Taiwan. Up to now, there is no supervision institution of judicial system. Some judges use judicial independence as a reason to avoid supervision.

3. The personnel authority reform

3.1 The personnel authority reform in judiciary

The promotion, transfer, discipline, and punishment of judiciary personnel are controlled by the Judicial Council. Before the judicial reform movement, the operation of Judicial Council was a black box: it approved the personnel affairs that were sent by Judicial Yuan as a rubber stamp. In 1994, however, three reform-minded judges became the Judicial Council members and began resisting some controversy proposals of judges' positions successfully. Furthermore, Shih Chi-yang (施啟揚), the President of the Judicial Yuan, appointed a reform-minded judge, Lu Tai-lang (呂太郎), to be the director of personnel department. It means reform-minded judges have been changing their status from negative defense to positive reform.

3.2 The personnel authority reform in prosecution

In prosecution, the most important act of the Prosecutors' Reform Association (PRA), which was established in 1998, was that its members participated in the Prosecutorial Council. Although the functions of Prosecutorial Council was similar as the Judicial Council in Judicial Yuan, but there was no legitimacy about Prosecutorial Council, and its authority was inferior extremely to Judicial Council, and did not final say personnel affairs. The Prosecutorial Council had only personnel consultative function for the Minister of Justice. Besides, the chairman of Prosecutorial Council was the Vice Minister but not the Minister of Justice. On the contrary, the President of the Judicial Yuan is the chairman of Judicial Council.

After PRA's members participated in the Prosecutorial Council, they had two ways could reduce the control of KMT and the Ministry of Justice. First, they broken the promotion mechanism in prosecutorial system, and blocked the questionable personnel proposals. The second function was to protect the local level prosecutors to avoid the political oppression. Besides, PRA and other non-governmental judicial reform organizations strived for amending the law for a long time and carried out the further progresses: the first important historical progress is to amend the of Attorney General's appointment procedure that he/she was nominated by the President and approved by Legislative Yuan. The second is Prosecutorial Council obtained the legitimacy.

4. The comparison between Judicial Council and Prosecutorial Council

Although Judicial Council and Prosecutorial Council both have powerful authority of promotion and punishment of judges and prosecutors, and the structure of members are very similar, but there is a very different political character on "judicial independent" and "democratic accountability". The leader of personnel affairs in Judicial Council is the President of the Judicial Yuan. The appointment of the President of the Judicial Yuan has the nature of politics, but there are two causes decreased its political character. First, the President of the Judicial Yuan, Weng Yueh-sheng (翁岳生), is one of the Justice of Constitutional Court, and his career almost in the academia and the Justice of Constitutional Court. He has no remarkable works and experience for politics. As the reason, the political natural appointment of the President of the Judicial Yuan is "judicialization," therefore it could not bring any influence from

democratic politics into the Judicial Yuan. Second, all appointments must be considered by Judicial Council, in which, all the members are judges; they have no political experience nor the check and validation from political department. Therefore, the judges are difficult to understand the criterion and expectation from politics and society.

The relationship between Prosecutorial Council and political department, however, is very different. First, the Prosecutorial Council has no authority to determine any appointment proposal, especially the key position like the chief prosecutors. The Prosecutorial Council is only consulted passively. Second, although the appointment of the Minister of Justice and the President of the Judicial Yuan has both political nature, but the former may loss his position because he is controlled by politicians or political parties absolutely. That is, the political natural of appointment of the President of the Judicial Yuan is “judicialization”, but the appointment of the Minister of Justice who came from judicial system is “politicalization.” If the politicians or political parties have power to appoint or replace the position of the Minister of Justice, the latter will be “politicalization” under political pressure. It means the political authority would influence the important personnel affairs of prosecuto-rial system.

The President of the Judicial Yuan and the Minister of Justice couldn't determine any personnel case by themselves. They need help from other staff. The main officer of personnel affairs in Judicial Yuan is the director of personnel department, and some reform-minded judges had taken up the post. On the contrary, reform-minded prosecutors have never been the important officers in the Ministry of Justice. Some prosecutors trusted and appointed by the Ministry of Justice under the DPP government were conservative and promoted by the KMT authoritarian regime.

In short, the major difference between Judicial Council and Prosecutorial Council is the former lacks the democratic accountability. Without a few exceptions (e.g. the Justice of Constitutional Court), democratic politics influenced judicial personnel difficultly. However, the Minister of Justice has the authority and can control the appointments of the chief prosecutors. It makes the prosecutorial independence eroded seriously. The more important point is that the prosecutorial system has more democratic accountability while the Minister of Justice can control the of personnel appointments. If the Minister of Justice does not make appropriate appointment, people can change the Minister of Justice or the ruling party by democratic process.

5. Emphasizing internal democratic autonomy; ignored external democratic supervision

For solving the problems, in past, reform-minded judges used “democracy” as the strategy to against the stratification in judicial system and so call “judicial ethics”, and mobilized many judges who were not key members in the reform movement. The democratic means made local level judges' power expansion and increased their independency, and weakened the control from the Judicial Yuan. But these reform-minded judges' definition of “democracy” was very narrow: it was only in the internal of judicial system, but not considered the relation between judicial system and other political and social departments further, not discussed with the role that judicial system should play under democracy politics, not understood how the judicial system should be accountable to democratic politics and people. It means, there was no consideration about how the judicial system could be supervised by democratic politics. The same as the judges' movement, some reform-minded judges and politicians asked for the revision of law to take the personnel appointments of the chief prosecutors into the provision of the Prosecutorial Council, and asked for the democratization (Chen ed., 1999).

Why did these reform-minded judges and prosecutors choose the internal democracy of judicial system for movement strategy but ignore the much serious problem of democratic political system? The most important reason is the defect and bad nature of Taiwan's democratic politics makes reform-minded judges and prosecutors to fear that if letting the democratic institution into the judicial system will provide politics to intervene the judiciary. Besides, even the judicial system lacked external supervision (or over-independent); it still contributed to the reform of Taiwan society. For example, in middle 1990s, Ping-tung (屏東) District Prosecutors Office had cleared the Black Gold (political corruption) by the prosecutors who kept independence.

6. Rethinking about Judicial Council and Prosecutorial Council

The European and Latin American countries' experiences of Judicial Council could be the good mode for Taiwan. First, the multiple of Council members included both judicial and non-judicial delegates, and the member structure can give the consideration to judicial profession and social demand at the same time. Second, the members of Judicial Council in most countries, whether elected from judiciary or lawyers, are all through the democratic process and have democratic legitimacy, for example, appointed by the President or Congress. It means the members of Judicial Council have the accountability to politicians or democratic institution. If we consider the "Judges Law draft" from the non-government judicial reform organization, we should ask the directors and trustees of the Judicial Evaluation Foundation and the members of Judge Election Committee should be appointed by Legislative Yuan. This institutional mode would be a better solution for the dilemma between democratic accountability and judicial independence.

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The reactor design and comparison of Fenton, electro-Fenton and photoelectro-Fenton processes for mineralization of benzene sulfonic Acid (BSA)

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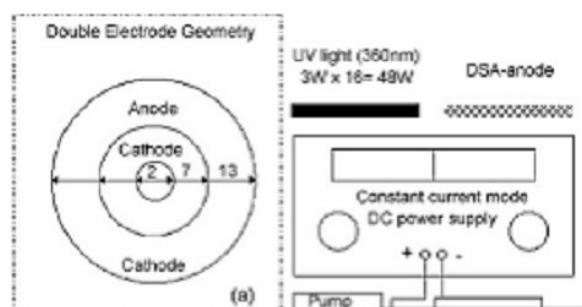
Journal of Hazardous Materials 156 (2008) 421–427

A new approach of photoelectro assisted Fenton process has been developed in our laboratory. It is found that the Fenton reaction can be efficiency enhanced in photoelectro assisted Fenton process since $Fe(III)$ may complex with certain target compounds or byproducts, especially those acting as ligands, produced by UVA light and current. The new design of our system came from the concept of promoting the ferric reduction rate, which can increase the amount of hydroxyl radicals. Literatures reported that oxalic, formic and acetic acids are the major products of aromatic compound degradation, which can complex with ferric ions. These complexes typically have higher molar absorption coefficients in the UV and visible regions to generate ferrous ions. Meanwhile, the ferrous ion is regenerated via the reduction of ferric ion on the cathode. However, the reaction mechanism of ferric ion reduction is still unclear. Therefore, a functional reactor was designed to save energy and to clarify the mechanism of ferric reduction with UVA light and electricity.



A new electro-chemical cell was developed to increase the working area and promote the current efficiency. The operation parameters, such as single and double electrode effect, electrode distance, initial pH, Fe^{2+}/H_2O_2 molar ratio, applied current, H_2O_2 feeding mode were investigated, firstly. Then some tests were used to explore the effect of Fenton, electro-Fenton and photoelectro assisted Fenton process. Finally, in this dissertation, the intermediate of oxidation process was identified and the mechanisms were proposed.

Fig. 1 shows the schematic experimental setup of this study. The cylindrical reactor (radius: 6.5 cm and height: 35 cm) was operated at a constant current mode. The total volume of the reactor is 3.5 liters. The anode used is titanium net coated with RuO_2/IrO_2 (DSA), and the cathode is made of stainlesssteel. Three different cathode geometries



were tested. Fig. 1(a) shows double electrode cell: with a inside diameter 7 cm DSA net as anode, 2 cm and 13 cm stainless steel wall as cathode; Fig. 1(b) shows single electrode cell: with a inside diameter 7 cm DSA net as anode and 13 cm stainless steel wall as cathode; Fig. 1(c) shows single electrode cell: with a inside diameter 2 cm DSA net as anode and 13 cm stainless steel wall as cathode.

Fig. 2 showed that the electrochemical method could hardly remove COD from the BSA solution. In this method, hydroxyl radicals would be produced at the surface of a high-oxygen overvoltage anode from water oxidation.



However, electrolysis did not oxidize with time since the overvoltage of DSA anode is not enough for amount of $\bullet\text{OH}$ generated. In the electro-Fenton process, COD was removed rapidly during the first 20 min. The final COD removal efficiency achieved by the electro-Fenton process was nearly 17% higher than that of the Fenton's reagent alone. Meanwhile, the photoelectron-Fenton process achieved a COD removal efficiency that was 14% higher than that of the electro-Fenton process. This indicated that the photoelectron-Fenton method had synergistic effect for COD removal.

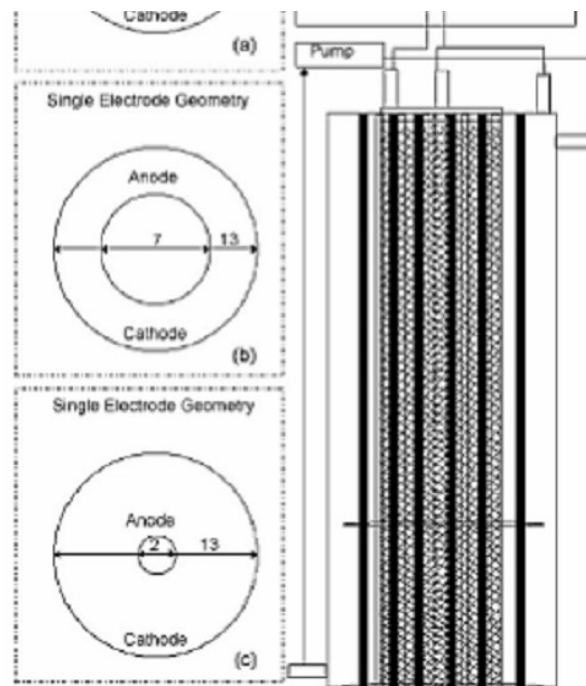


Fig. 1 (a–c) Schematic diagram of reaction system.

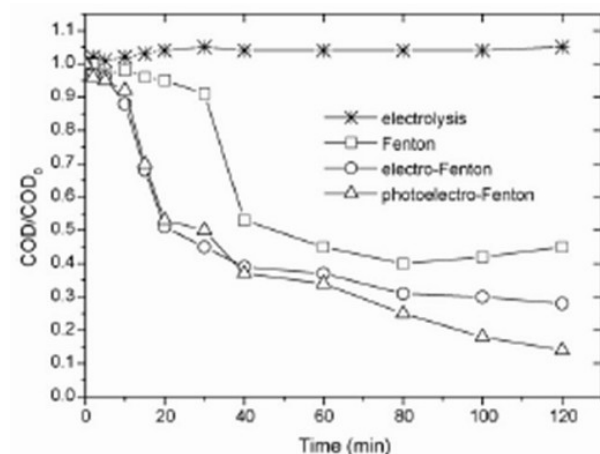


Fig. 2 Effect of different processes on COD removal efficiency ([BSA]=10mM; $[\text{Fe}^{2+}] = 8 \text{ mM}$; $[\text{H}_2\text{O}_2]$ overall = 166 mM; pHi 2.0; CDa = 75.8 A/m^2 ; CDc = 71.0 A/m^2 ; H_2O_2 feeding time = 0, 5, 10, 15, 20, 30, 40, 60, 80, and 100 min).

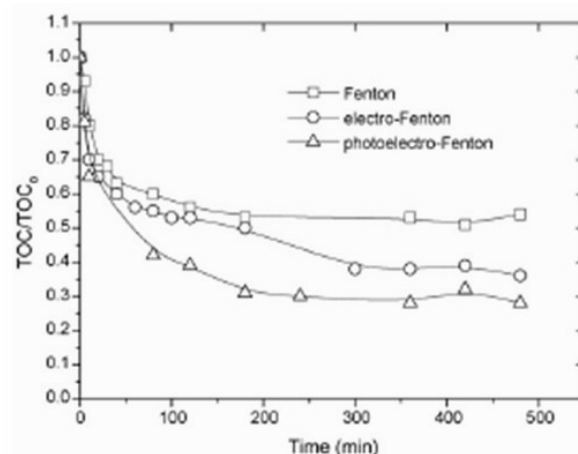


Fig. 3 Mineralization of BSA with different processes. ([BSA] = 10 mM; $[\text{Fe}^{2+}] = 8 \text{ mM}$; $[\text{H}_2\text{O}_2]$ = 166 mM; pHi 2.0; CDa = 75.8 A/m^2 ; CDc = 71.0 A/m^2).

To investigate the synergistic effect of combined irradiation, electrochemical method and Fenton's reagent, 720 mg/L TOC of BSA solution was treated with Fenton reagent alone, the electro-Fenton method alone and the photoelectro-Fenton method, respectively. Fig. 3 shows that the Fenton process could only slightly remove TOC from the BSA solution. Furthermore in both the electro-Fenton and the photoelectro-Fenton processes, TOC was removed faster during the first hour. After that, only slow changes in TOC were

observed because ferric ion was complexed by oxidation products such as oxalic acid. The degradation of aromatic compounds often leads to the formation of intermediates such as glyoxylic, maleic, oxalic, acetic and formic acids. Fig. 4 indicates the formation of oxalate acid and formic acid. Oxalate acid would be reduced from the electro-Fenton and photoelectro-Fenton processes. As result of Fig. 4, the ferric complexes would be reduced to ferrous ion from the photo-reduction and by reduction in the cathode. This would induce the Fenton chain reaction efficiently.

The photochemistry of Fe^{3+} is advantageous to the Fenton process because the reduced iron can react with H_2O_2 to oxalate to the reaction solution and observed the photoreduction of the resulting ferrioxalate complexes and obtained degradation of aromatic and chlorinate aromatic hydrocarbons. However, photodecomposition of Fe^{3+} complexes produced some short organic acids, which are produced in the last degradation steps before total conversion to CO_2 . This is especially relevant with regard to the oxalic acid mineralization. The ferric complexes would be reduced to ferrous ion from the photo-reduction and by reduction in the cathode. This would induce the Fenton chain reaction efficiently.

The effect of electrode geometry and different oxidation methods were investigated to evaluate reactor design and mineralization efficiency. The double cathode reactor could increase the working area and enhance the current efficiency by 7%, which would translate to greater ferrous production and a higher degradation rate of organic compounds in the electro-Fenton process. It should be pointed out that the double cathode electrochemical cell has more potential for the improvement of the efficiency of electricity utilization.

The result also suggests that the electrode distance 3.0 cm device can provide more economical operation. The final COD removal efficiency achieved by the electro-Fenton process was 17% higher than that using the Fenton's reagent alone. Meanwhile, the photoelectro-Fenton process achieved a COD removal efficiency that was 14% higher than that of the electro-Fenton process. The same tendency was shown in the TOC removal. This indicates that the photoelectro-Fenton method had a synergistic effect for mineralization. Oxalic acid, the major intermediate of aromatic compound degradation, can complex with ferric ions. The ferric complexes would be reduced to ferrous ion from photo-reduction and by reduction in the cathode. This would induce the Fenton chain

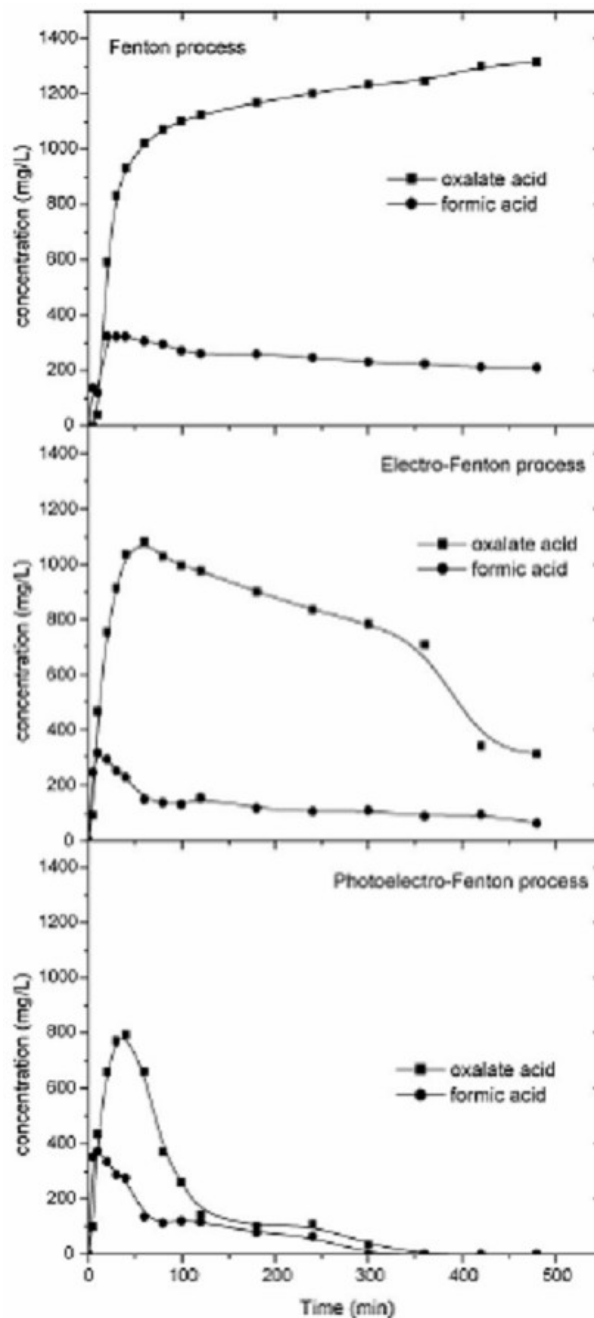


Fig. 4 Formation of organic acid by the degradation of BSA ($[\text{BSA}] = 10 \text{ mM}$; $[\text{Fe}^{2+}] = 8 \text{ mM}$; $[\text{H}_2\text{O}_2] = 166 \text{ mM}$; $\text{pHi} = 2.0$; $\text{CDa} = 75.8 \text{ A/m}^2$; $\text{CDc} = 71.0 \text{ A/m}^2$).

reaction efficiently.

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