TSCFA台灣超臨界流體協會
Taiwan Supercritical Fluid Association

電子報第 212 期

活動訊息

- ***14 th ISSF(International Symposium on Supercritical Fluids)& 9th ISHA (International Solvothermal and Hydrothermal Association Conference)***
  日期：**JUNE 15-20, 2025**
  地點：Bali, Indonesia
  CHAIR：JAEHOON KIM, SOUTH KOREA
  Scientific Meetings – ISASF (supercriticalfluidsociety.net)
  ※協會將組團由理事長帶隊前往，屆時歡迎會員踴躍參加！

會員動態

- 恭賀亞果生醫謝達仁執行長與張冠張教授合作人機界面/腦機界面的成果發表在國際知名期刊，並且登上封面！！
- 恭賀本會團體會員亞果生醫(股)公司榮獲『第 21 屆國家新創獎』！

淨零永續

- 產業節能減碳資訊網 INDUSTRIAL ENERGY SAVING AND CARBON REDUCTION INFORMATION WEB
  https://ghg.tgpf.org.tw/
- 淨零永續學校
  https://college.itri.org.tw/nzschool/

團體會員介紹

- 聯華氣體工業股份有限公司

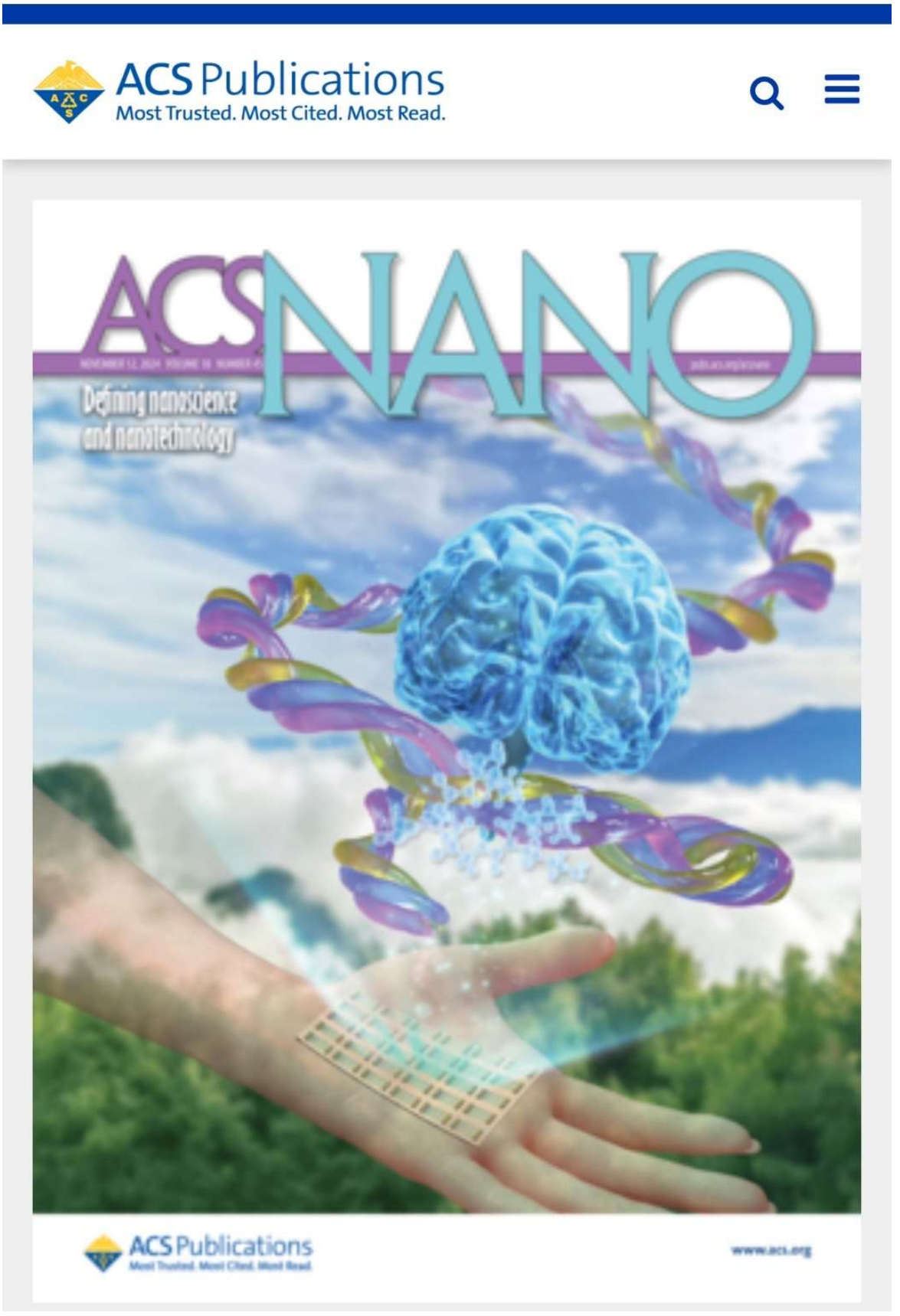
技術文摘

- Biocompatible Acellular Dermal Matrix-Based Neuromorphic Device with Ultralow Voltage, Ion Channel Emulation, and Synaptic Forgetting Visualization Computation (具有超低電壓、離子通道模擬和突觸遺忘可視化計算的生物相容性基於脫細胞真皮基質的神經形態器件)
- Determination of morphine sulfate anti-pain drug solubility in supercritical CO_2 with machine learning method (機器學習法測定硫酸嗎啡止痛藥在超臨界 CO_2 中的溶解度)
- Elucidating supercritical fluid extraction of fucoxanthin from algae to enable the integrated biorefinery (闡明超臨界流體從藻類中提取藻褐素以實現整合生物精煉)

- Experiment evaluation and thermodynamic analysis of pulping modification on ordered conversion of bark in supercritical water (樹皮於超臨界水中有序轉化製漿改質實驗評估及熱力學分析)
- Preparation of Mesophase Pitch through Supercritical Fluid Extraction of Coal Tar Pitch (超臨界流體萃取煤焦油瀝青製備中間相瀝青)
- The steady behavior of the supercritical carbon dioxide natural circulation loop (超臨界二氧化碳自然循環迴路的穩態行為)
- The transport of bismuth in HCl-bearing aqueous vapour and low-density aqueous supercritical fluids: Implications for natural systems (含 HCl 的水蒸氣和低密度水性超臨界流體中鉍的傳輸：對自然系統的影響)

恭賀亞果生醫謝達仁執行長與張冠張教授合作人機界面/腦機界面的成果發表在國際知名期刊，並且登上封面！！

生醫材料與半導體的結合是未來重要的發展趨勢



恭賀本會團體會員亞果生醫(股)公司榮獲『第 21 屆國家新創獎』！

🎉【賀！亞果生醫再添喜訊】🎉

「去細胞真皮微粒」於醫療器材創新應用領域，榮獲第 21 屆國家新創獎 - 企業新創獎的肯定！

今年，這項技術已三度傳來捷報：

✅四月獲得台灣衛福部第三等級醫材許可證

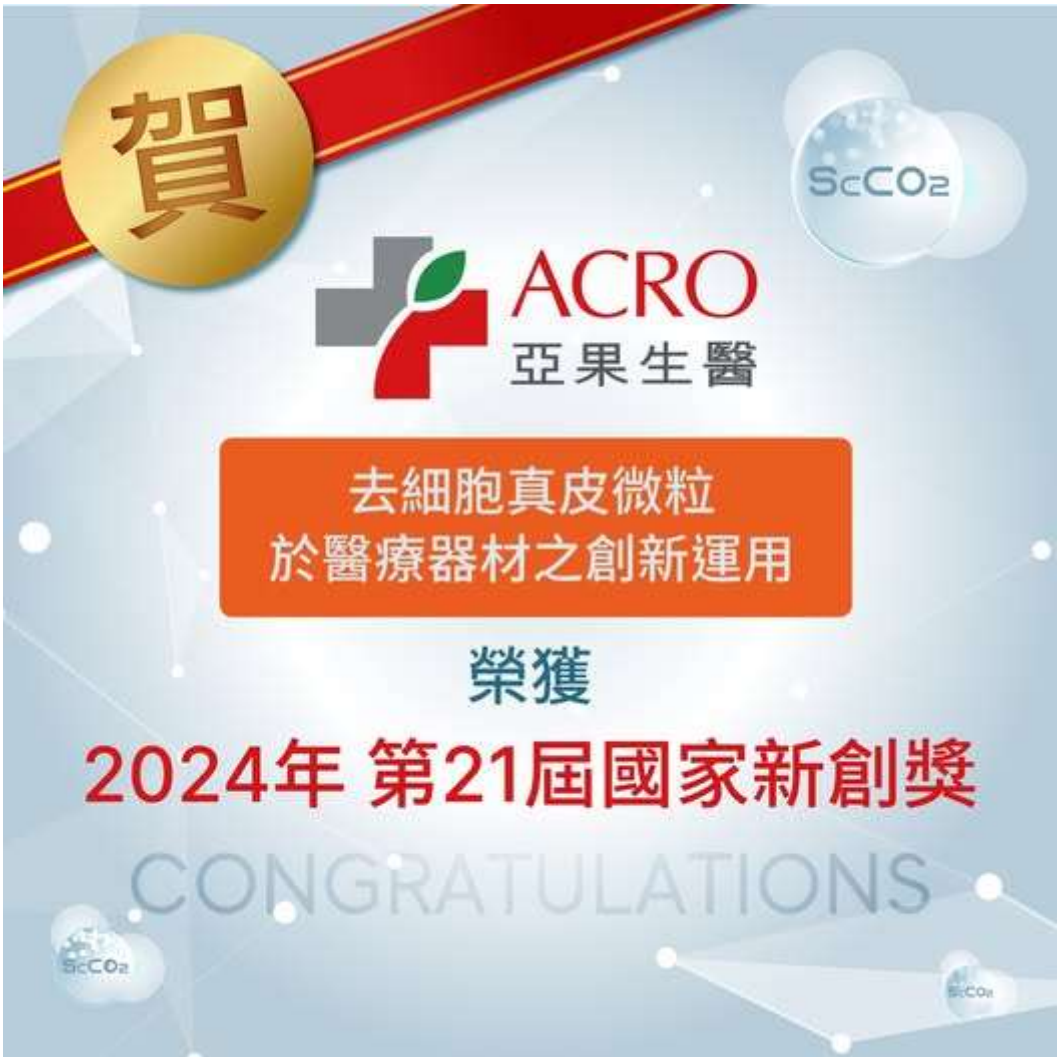
✅ABCcolla® Collagen ADM Scaffold 成功取得美國 FDA 510(k)銷售許可

✅榮膺國家新創獎，實力再度獲得認證！

🎊三喜臨門，實至名歸！ 🎊

亞果生醫的研發團隊更透過動物實驗證實，「去細胞真皮止血微粒」不僅能加速體內外傷口癒合，更展現促進毛髮增生的潛力！未來，我們期待此產品進一步進軍毛髮增生市場，為更多人帶來全新希望與可能！

🌟亞果生醫將持續以創新技術，邁向全球，實現醫療突破！ 🌟



聯華氣體工業股份有限公司

關於聯華林德

聯華氣體工業股份有限公司是由林德集團及聯華實業股份有限公司共同投資設立，主要業務為提供台灣各產業所必需之工業用氣體，高科技及半導體產業用之電子級氣體，以及醫療及食品製造所須之民生氣體。

聯華林德致力打造全方位氣體供應服務，聯華林德的專長和能力涵蓋整個氣體供應鏈 - 從氣體生產設施的設計和建造，到運行、配送、氣體應用解決方案、安裝和量身定制的物流支持。同時，聯華林德擁有非常齊全的產品線，包含管道輸氣、槽罐車輸氣及瓶裝氣體填充等業務服務。

聯華林德所提供的專業的技術及服務，為台灣的科技產業以及民生工業打下厚實的營運基礎。

穩定的供氣服務

聯華林德擁有全國最大的氣體供應量，並且有科學園區及工業區的地下管路網，及專屬於聯華林德的運輸團隊，更有各式規格的設備，可供客戶選擇以增加未來擴充之彈性。並採取備品集中管理，將維修時程壓縮至最迅速，並且有最專業的客服人員可以幫助客戶在最短的時間內解決所有問題。聯華林德並且與國際氣體大廠 Linde 的技術合作，可以提供客戶最先進且最穩定的特殊氣體供應。

目前聯華林德已通過 ISO:9001、ISO14000、OHSAS18000、FSSC 22000 食物安全管理系統 (Food Safety System Certification 22000, FSSC 22000)…各項認證，能夠在符合安全環保的條件下，提供客戶最可靠品質優良的產品，目前國內電子大廠皆為聯華林德之忠實客戶，憑藉就是聯華林德優良的產品供應鏈，以及龐大的運輸團隊，並且有將客戶的滿意當成重要目標之一的專業客服人員。

供應系統與設備

- 整廠供氣設備
- 特殊大宗氣體設備
- 氣體櫃
- 混合氣系統設備

聯華氣體 氣體解決方案供應商

Total Solutions Provider for Gas Supply.

聯華氣體工業股份有限公司是由林德集團及聯華實業股份有限公司共同投資設立，是台灣最大的工業氣體製造商，身為台灣氣體工業製造的領導者，我們的專長和能力涵蓋整個氣體供應鏈——從氣體生產設施的設計和建造，到運輸、配送、氣體應用解決方案、安裝和量身訂製的物流服務。

專注客戶需求與市場發展趨勢，為各行各業開發一系列的氣體生產裝置和供應方案，提供眾多氣體產品和相關解決方案以滿足客戶的需求。

管路供應方案 Pipeline Distribution

大宗氣體供應方案 Bulk Distribution

現場供氣方案 On-site Distribution

瓶裝氣體供應方案 Cylinder Distribution

聯華氣體工業股份有限公司　電子產業相關 訂單/客服專線：(03)5783876　綜合產業相關 訂單/客服專線：4498-398

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Biocompatible Acellular Dermal Matrix-Based Neuromorphic Device with Ultralow Voltage, Ion Channel Emulation, and Synaptic Forgetting Visualization Computation

具有超低電壓、離子通道模擬和突觸遺忘可視化計算的生物相容性基於脫細胞真皮基質的神經形態器件

By **Lei Li, Yihua Xu, Qunkai Peng, Pei Huang, Xinqing Duan, Mingqiang Wang, Yu Jiang, Jie Wang, Srinivasan Periasamy, Dar-Jen Hsieh, Kuan-Chang Chang***

Guangdong Provincial Key Laboratory of In-Memory Computing Chips, School of Electronic and Computer Engineering, Peking University, Shenzhen 518055, P. R. China

R&D Center, ACRO Biomedical Co., Kaohsiung City 82151, Taiwan

Abstract

Neuromorphic bioelectronics aim to integrate electronics with biological systems yet encounter challenges in biocompatibility, operating voltages, power consumption, and stability. This study presents biocompatible neuromorphic devices fabricated from acellular dermal matrix (ADM) derived from porcine dermis using low-temperature supercritical CO_2 extraction. The ADM preserves the natural scaffold structure of collagen and minimizes immunogenicity by eliminating cells, fats, and noncollagenous impurities, ensuring excellent biocompatibility. The ADM-based devices emulate biological ion channels with biphasic membrane current modulation, exhibiting temperature dependency and pH sensitivity. It operates at an ultralow voltage of 1 mV and demonstrates reliable synaptic modulation exceeding 4×10^4 endurance cycles. The activation voltage can be theoretically as low as 59 μV, comparable to brainwave signals with a power of merely 7 aJ/event. Furthermore, a brain-like forgetting visualization algorithm is developed, leveraging the synaptic forgetting plasticity of ADM-based devices to achieve complex computing tasks in a highly energy-efficient manner. Neuromorphic devices based on ADM not only hold potential in implantable biointerfaces due to their exceptional biocompatibility, ultralow voltage, and power but also provide a feasible way for energy-efficient computing

Keywords: *Biocompatibility, Energy, Ions, Membranes, Power*

資料來源：https://doi.org/10.1021/acsnano.4c10383

Determination of morphine sulfate anti-pain drug solubility in supercritical CO_2 with machine learning method

機器學習法測定硫酸嗎啡止痛藥在超臨界 CO_2 中的溶解度

By **Gholamhossein Sodeifian, Chieh-Ming Hsieh, Farnoush Masihpour, Amirmuhammad Tabibzadeh, Rui-Heng Jiang & Ya-Hung Cheng**

Department of Chemical Engineering, Faculty of Engineering, Laboratory of Supercritical Fluids and Nanotechnology, and Modeling and Simulation Centre, Faculty of Engineering, University of Kashan, Kashan, Iran

- Department of Chemical and Materials Engineering, National Central University, Taoyuan, Taiwan

Abstract

Accurate solute solubility measuring and modeling in supercritical carbon dioxide ($ScCO_2$) would address the best working conditions and thermodynamic boundaries for material processing with this type of fluid. Theory- and data-driven methods are two general modeling approaches. Using theory-driven methods, the solubility is estimated based on the principles of thermodynamics, while data-driven methods are developed by training the algorithms. Despite acceptance of each of these methods, more experimental solubility data are still needed to promote modeling performances. In this study, for the first time, solubility of morphine sulfate is determined and modeled by a set of 13 semi-empirical (theory-driven) and random forest (data-driven) models. Using a laboratory system with an ultraviolet-visible (UV-Vis) spectroscopy, the experimental solubilities including 48 data points were obtained at different temperatures (308–338 K) and pressures (12–27 MPa). The minimum (0.806×10^{-5}) and maximum (5.902×10^{-5}) equilibrium mole fractions were observed at working pressures of 12 and 27 MPa, respectively, both at the same temperature of 338 K. It was indicated that random forest model (with AARD% of 1.29%) had an excellent predictive performance against semi-empirical models (with AARD% from 9.33 to 19.76%). The results showed that solute molecular weight had the highest effect on random forest modeling. Using modeling results from Chrastil and Bartle models, total and vaporization enthalpies of dissolution of morphine sulfate in $ScCO_2$ were found to be 35.12 and 59.04 kJ/mole, respectively.

資料來源：https://www.nature.com/articles/s41598-024-73543-0

Elucidating supercritical fluid extraction of fucoxanthin from algae to enable the integrated biorefinery

闡明超臨界流體從藻類中提取藻褐素以實現整合生物精煉

By **Mary Kate M. Lane [a b 1], Elise B. Gilcher [b c 1], Melissa M. Ahrens-Víquez [a], Rachel S. Pontious [a], Nora E. Wyrtzen [d], Julie B. Zimmerman [a b c]**

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[c] School of the Environment, Yale University, 195 Prospect St, New Haven, CT 06511, USA

[d] Environmental Studies, Yale College, 1 Prospect St, New Haven, CT 06511, USA

Abstract

The emerging nutraceutical, fucoxanthin, shows promise as a high-value product to enable the integrated biorefinery. Fucoxanthin can be extracted from algae through supercritical fluid extraction (SFE), but literature does not agree on optimal extraction conditions. Here, a statistical analysis of literature identifies supercritical carbon dioxide ($scCO_2$) density, ethanol cosolvent amount, and polarity as significant predictors of fucoxanthin yield. Novel SFE experiments are then performed using a fucoxanthin standard, describing its fundamental solubility. These experiments establish solvent system polarity as the key knob to tune fucoxanthin recovery from 0% to 100% and give specific operating conditions for targeted fucoxanthin extraction. Further experiments compare extractions on fucoxanthin standard with extractions from *Phaeodactylum tricornutum* microalgae to elucidate the effect of the algae matrix. Results show selectivity of fucoxanthin over chlorophyll in $scCO_2$ microalgae extractions that was not seen in extractions with ethanol, indicating a benefit of $scCO_2$ to design selective extraction schemes.

資料來源：https://doi.org/10.1016/j.biortech.2024.131036

Experiment evaluation and thermodynamic analysis of pulping modification on ordered conversion of bark in supercritical water

樹皮於超臨界水中有序轉化製漿改質實驗評估及熱力學分析

By **Hui Ge, Yong Huang, Zhaozheng Liu, Fan Liu, Yu-Nan Chen, Liejin Guo**

State Key Laboratory of Multiphase Flow in Power Engineering, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an 710049, China

Abstract

Major obstacles of supercritical water gasification (SCWG) of lignocellulosic biomass, including ineffective pulping for energy self-sufficiency and a high conversion barrier significantly inhibited its large-scale development. In this study, the pulping effect of alkaline and salt pulping for high concentration bark slurry were compared systematically. The SCWG performances of bark (non-catalytic/catalytic) and bark slurry were evaluated. Based on energy self-sufficiency, a novel SCWG process of 50 wt% bark slurry was designated with a multistage reactor configuration and pulping process. The findings suggest that alkaline pulping had a wider applicability (reaching 50 wt%) and better rheological properties than salt pulping. Only 30 wt% bark slurry was capable for applying salt pulping because of solid residue with the excessive salt addition. Alkaline pulping resulted in an ordered conversion of 5 wt% and 10 wt% bark slurries during SCWG, with complete gasification of 5 wt% bark slurries prepared by KOH and NaOH at 650 and 680 °C, respectively. Besides, alkaline and salt pulping reduced the 26 % and 33 % carbon emissions, respectively. In the novel process, the optimal ratio of preheated water to bark slurry was 4 (water diversion to the primary and secondary gasification reactors of 1:3), which exhibits in energy and exergy efficiencies of 47.47 % and 48.63 %, respectively. This configuration reduces exergy losses in the gasification reactor and heat exchanger, aiding in the large-scale industrial output of SCWG.

資料來源：https://doi.org/10.1016/j.cej.2024.152157

Preparation of Mesophase Pitch through Supercritical Fluid Extraction of Coal Tar Pitch

超臨界流體萃取煤焦油瀝青製備中間相瀝青

By **Meng Wei, Zhiming Xu*, Suoqi Zhao**

State Key Laboratory of Heavy Oil Processing, China University of Petroleum, Beijing 102249, China

Abstract

This paper explores the preparation of mesophase pitch by employing supercritical fluid extraction on coal tar pitch sourced from a coal chemical company. The raw material undergoes pretreatment using various extraction solvents, and the resulting refined components are thermally polycondensed in a laboratory microreactor to create mesophase pitch. Qualitative and quantitative analyses of the mesophase pitch's structure are conducted through polarized light microscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), Raman spectroscopy, and other analytical methods to identify an optimal supercritical fluid extraction pretreatment solvent for coal tar pitch. The results reveal that using *n*-hexane solvent in the supercritical fluid extraction process yields a mesophase pitch with a remarkable mesophase content of 90.07%, displaying excellent optical texture distribution, superior directional arrangement and order, the closest lamellar accumulation, and the highest degree of anisotropy and graphitization.

資料來源：https://doi.org/10.1021/acsomega.3c08206

The steady behavior of the supercritical carbon dioxide natural circulation loop

超臨界二氧化碳自然循環迴路的穩態行為

By **Marko Draskic[a], Benjamin Bugeat[b], Rene Pecnik[a]**

[a] Process & Energy - ME, Delft University of Technology, Delft, The Netherlands

[b] School of Engineering, University of Leicester, Leicester, United Kingdom

Abstract

The steady state behavior of thermodynamically supercritical natural circulation loops (NCLs) is investigated in this work. Experimental steady state results with carbon dioxide are presented for supercritical pressures in the range of 80–120 bar, and temperatures in the range of 20–65 °C. Distinct thermodynamic states are reached by traversing a set of isochors. An equation for the prediction of the steady state of NCLs at supercritical pressures is presented, and its performance is assessed using empirical data. Changes of mass flow rate as a result of independent changes of thermodynamic state, heating rate, driving height and viscous losses are shown to be accurately captured by the proposed equation. Furthermore, close agreement between the predicted and measured mass flow rate is found when the measured equipment losses are taken into account for the comparison. Subsequently, the findings are put forward in aid of the development of safe, novel supercritical natural circulation facilities.

資料來源：https://doi.org/10.1016/j.energy.2024.130735

The transport of bismuth in HCl-bearing aqueous vapour and low-density aqueous supercritical fluids: Implications for natural systems

含 HCl 的水蒸氣和低密度水性超臨界流體中鉍的傳輸：對自然系統的影響

By **Xin-Song Wang [a], A.E. Williams-Jones [b], Rui-Zhong Hu [a], Qi Liu [a], Fei-Xiang Liu [a], Yuan Mei [c], Zi-Qi Jiang [a], Lin-Bo Shang [a], Jing-Jing Zhu [a], Xian-Wu Bi [a]**

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Abstract

Hydration by H_2O clusters has been shown to be an important means of transporting metal complexes in hydrothermal vapours and low-density supercritical aqueous fluids. However, the effect of hydration on the transport of relatively volatile metal complexes such as those involving bismuth and chloride has not been evaluated. This effect is important to evaluate because bismuth is a key pathfinder element for gold in many intrusion-related gold ore-forming systems, where low-density supercritical aqueous fluids and vapour may play an important role in metal transport. Here, we present the results of experiments investigating the solubility of BiOCl(s) and the speciation of bismuth in HCl-bearing aqueous vapour and low-density supercritical aqueous fluids at temperatures between 250 and 400 °C and pressures of 5 to 296 bar. Two gaseous bismuth species formed in the HCl-bearing fluids (X(HCl) > 0.0005), namely $BiCl_3(g)$ and $BiCl_3(H_2O)_n(g)$. Our data clearly show that $BiCl_3(g)$ is highly volatile at low water fugacity (between 30 and 110 bar) and acts as an unhydrated gas molecule. At higher water fugacity, the gaseous $BiCl_3(g)$ reacts with water to form hydrated $BiCl_3(H_2O)_n(g)$ species. Significantly, the stability of hydrated bismuth chloride species, $BiCl_3(H_2O)_n(g)$, with low hydration numbers is lower than that of the unhydrated species, $BiCl_3(g)$, resulting in a decrease in bismuth solubility with increasing $f(H_2O)$. However, at a water fugacity great than 30–110 bar, that increases with increasing temperature, the hydration number and the solubility of hydrated species $BiCl_3(H_2O)_n(g)$ increase with increasing water fugacity or the density of the fluid. Consequently, unhydrated gaseous bismuth species increase in importance with increasing temperature and become dominant at temperatures > 450 °C in fluids that have low density (<0.10 g/cm^3). Hydrated bismuth chloride species are dominant in

fluids having higher density (0.10–0.34 g/cm^3). The overarching conclusion of this study is that aqueous low-density supercritical fluids, which exsolve from magmas to form intrusion-related gold deposits, can transport bismuth in concentrations (up to hundreds ppm) sufficient to form economic deposits.

Keywords: *Hydrothermal experiments, Vapour, Bismuth, Solubility and speciation*

資料來源：https://doi.org/10.1016/j.gca.2024.06.008