附件四、技術說明表

氣體震盪式連續流體結晶暨反應器

提案人：郭修伯 教授
單　位：國立臺灣大學化學工程學系
簡　歷：長庚工學院副院長、化材系主任；台大化工系副主任、台大產學合作總中心主任

市場及需求:

食品、特化品、製藥產業中，結晶是常見的產品形態。市售結晶槽多是批式操作造成粒徑分布廣、過飽和度難以控制，或是以多效蒸發罐/結晶/離心/乾燥等冗長多單元製程完成結晶，連續結晶製程一直是個挑戰且存在廣大市場需求。我們開發出一種連續操作結晶槽，不僅不容易汙染流體，更能節省蒸發罐單元，生成粒徑均一的結晶或反應性產品。

技術摘要(含成果):

我們開發出一種連續操作結晶槽。利用氣體壓力(正壓或負壓)給予漿料頻率性的作動，利用壓力於管狀(但不限於)結晶槽中的流體兩端反覆轉向施作的方式，提供內部流體的移動能量。此外，在反應器內部設計擋板，使反應物漿料在管狀(但不限於)反應器移動過程中得到良好的混合。另，此管狀結晶槽可在外部裝置夾套施予精密溫度控制與過飽和程度。若以負壓方式進行，更可以氣化溶劑以簡化省去蒸發罐單元。此連續混合、輸送、過飽和度精密控制的新穎氣體震盪連續式流體結晶暨反應器是創新的新結晶設備。

【實施例】現階段以二氧化矽顆粒溶膠凝膠反應進行測試，已在氣體震盪式連續流體結晶暨反應器原型機中成功二氧化矽顆粒的溶膠凝膠反應合成。

優勢:

1. 連續操作
2. 由夾套溫度、檔板、負壓真空度、震盪頻率與震幅輕易控制混合均勻性與過飽和度
3. 無機械接觸，不容易汙染流體
4. 連續生成粒徑均一的結晶或反應性產品。

競爭產品:

現有批次反應器、批次結晶槽、機械往復式連續震盪式檔板反應器

專利現況:

機械往復式連續震盪式檔板反應器(Continuous Oscillatory Baffled Reactor, COBR)為類似發明，相關專利(主要是中國大陸與其他國家專利)如附件。這類型的專利，使用機械的往復式運動，造成流體在具有檔板的管狀反應器混合與輸送，可連續式的反應或結晶。但 COBR 使用機械式的原理讓流體往復運動，與此發明使用氣體壓力(正壓或負壓)造成流體的往復式運動不同。此新發明使用氣體壓力的震盪流體，不僅減少機械設備與流體接觸造成的汙染，若使用負壓時，更可以使溶劑飽和蒸氣壓大於外界壓力而汽化，造成流體的過飽和析晶、晶粒

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成長。此發明結合 COBR 連續反應器的優勢，減少機械與流體接觸的汙染，更能將蒸發罐與結晶罐的功效二合一，節省固定與操作成本。

聯絡方式(請不用填):

臺大產學合作總中心
Tel: 02-3366-9945,　E-mail: ordiac@ntu.edu.tw

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Gas Pressure-Driven Continuous Fluid Oscillating Crystallizer/Reactor

PI： Professor Hsiu-Po Kuo
Department of Chemical Engineering, National Taiwan University
Experience: https://che.ntu.edu.tw/che/hsiupokuo.html

Market Needs:

Products from the crystallization process are commonly encountered in food, fine chemical, pharmaceutical and other industries. General crystallization tanks are in batch operations, and the crystals produced typically have large size distributions and the degrees of supersaturation are difficult to be controlled. The entire process may involve evaporator, crystallizer, centrifugal separator, drying and other units. Continuous crystallization process has always been a challenge and the potential market is huge.

Our Technology:

We have developed a continuous crystallizer using gas pressure (positive pressure or negative pressure) with certain oscillating frequent to act on the fluid therein a tubular crystallizer. The fluid can then be transported and the solvent therein can be evaporated when applying negative pressure. In addition, baffles are designed inside the reactor to ensure that the reactants are well mixed during the back-and-forth transportation. In addition, the temperature controlled jacket can be added on the tubular crystallizer to control the supersaturation of the fluid. In addition, when applying negative pressure, solvent can be evaporated to enhance the supersaturation and to omit the evaporator unit. This novel "Pressure-Driven Continuous Fluid Oscillating Crystallizer/Reactor" continuously feed, mix, transport and produce good quality crystalline products in a simply maintained and operation device.

At present, we have successfully synthesis silica particles the prototype "Gas Pressure-Driven Continuous Fluid Oscillating Crystallizer/Reactor" through the sol-gel reaction.

Strength:

1. Continuous operation
2. The degrees of mixing and supersaturation can be easily controlled by the jacket temperature, baffle design, pressure, oscillating frequency and amplitude
3. Continuously harvest crystals and/or reaction products with uniform size distributions

Competing Products:

Current batch reactor, batch crystallizer, mechanical continuous oscillating baffled reactor in the market

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Intellectual Properties:

Similar inventions are mechanical Continuous Oscillatory Baffled Reactor (COBR). The filed patterns in PROC are in the attachment. These patterns use mechanical oscillating pistons to mix and transport fluid in the baffled tubular reactor, which can produce crystals and/or reaction products continuously. Yet, the current invention use gas (positive or negative) pressure, instead of mechanical oscillating pistons, to allow the fluid in the COBR to be mixed and transported. This new invention avoids the possible contaminations from the fluid-direct-contact mechanical oscillating piston and easily control the degree of supersaturation through the solvent evaporation when applying the negative pressure mode. This new invention can reduce the possible contamination from vibrator and omit the evaporation unit in the crystallization process.

Contact (do not need to fill out):

Center for Industry-Academia Collaboration, NTU
Tel: 02-3366-9945, E-mail: ordiac@ntu.edu.tw

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