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RISE

Intensified Flow Process toward Biobased Glycerol Carbonate

KEY ACHIEVEMENTS

- A hydrochlorination/dechlorination sequence of glycerol yielding glycidol is validated a pilot scale. The process is intensified under continuous flow conditions and requires less than 2 min for each step.
- A **continuous flow process** is validated at the pilot scale for the subsequent coupling of glycidol and CO_2. The process is intensified and reaches **~80% yield in less than 30 s**.
- The **CO_2 coupling** with glycidol is catalyzed by a widely available commercial nitrogen-containing organocatalysts (1 mol%).
- Downstream purification includes liquid-liquid extraction and distillation.

KEY COMPETITIVE ADVANTAGES

- Unprecedented process toward high value added biobased glycerol carbonate feeding upon low cost industrial wastes.
- The overall process is associated with a **low environmental factor** (E-factor = 4.7).
- The process is **validated at pilot scale** in a commercial mesofluidic reactor and ready to be transposed to commercial scale.
- Reactor effluents can be recycled through simple separation processes.
- Glycerol carbonate is obtained in >95% purity.

UPCOMING CHALLENGES

- Capital investment for the transposition to commercial scale with production mesofluidic reactors

INTELLECTUAL PROPERTY

Patent pending (PCT/EP2024/055382)

Ambitious R&D and production directives in Europe are stimulating the integration of innovative technologies to reduce environmental impact and to move away from an exclusive reliance on petrochemical resources. In this context, a new process feeding upon molecules derived **from biomass and from industrial wastes** was developed. Glycerol is mainly derived from the biodiesel industry and cooking oil recycling; its low economic value has relegated it to the status of waste until now. Another waste turned public enemy number one, CO_2, is an industrial gaseous effluent with low economic value.

Glycerol carbonate, which formally results from the condensation glycerol and CO_2, has recently become a rising star. It offers several advantages over other petroleum-based carbonates such as ethylene and propylene carbonates, which are key electrolyte carriers in lithium batteries. Its significantly lower flammability could greatly reduce inherent fire risks associated with classical petrobased carbonates. Glycerol carbonate can also be used as a **biolubricant, formulation agent, or alternative green solvent**. Despite such potential, the current market for glycerol carbonate remains very limited. The main reason is that current production processes are slow and expensive.

This process uses the inherent features of mesofluidic reactor technology for intensified gas-liquid conditions. The process, validated at the pilot scale, transforms a direct derivative of glycerol, namely glycidol, in the presence of CO_2 and an organic catalyst into glycerol carbonate. The efficiency of the process, which reaches completion in less than 30 seconds, far surpasses all current processes for glycerol carbonate production. Such favorable metrics open unprecedented perspectives for potential future industrialization.

PARTNERSHIP SOUGHT

- We are looking for industrial partners interested in implementing this process toward glycerol carbonate at commercial scale
- We are looking for suppliers or end-users interested in biobased glycerol carbonate

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