SUCCESS STORY

RCPE GmbH

Research Center Pharmaceutical Engineering GmbH

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Project leader Prof. C. Oliver Kappe and former Area Leader David Cantillo developed the spinning-electrode reactor
Photo: Tzivanopoulos, Uni Graz

COMPLEX CHEMISTRY, SAFELY SCALED – SPINNING-ELECTRODE REACTOR FOR INDUSTRIAL NEEDS

A NOVEL SPINNING-ELECTRODE REACTOR ENABLES SAFE, ROBUST SCALE-UP OF CHALLENGING ELECTROCHEMICAL REACTIONS

Many pharmaceutical and chemical companies avoid hazardous chemical transformations such as oxidative process steps on a larger scale, even though they are central to the synthesis of numerous active ingredients. Such reactions are considered risky, difficult to control and demanding in terms of regulatory requirements – particularly when toxic reagents are generating large amounts of harmful waste.

To overcome these hurdles, a novel electrochemical reactor with a spinning electrode was developed at RCPE GmbH and University of Graz. A spinning cylinder intensively mixes the liquid, keeps solids suspended and reliably removes gases from the reaction zone. In this way, demanding electrochemical oxidative reactions (among many other types of transformations) can be carried out much more safely and more robust, from laboratory up to kilogram-scale – even in the presence of suspensions.

The starting point was a specific need from drug synthesis: for the production of the opioid antagonists naloxone and naltrexone, electrochemical N-demethylations were required that could be performed robustly on an industrially relevant scale, project leader Prof. C. Oliver Kappe explains. As no suitable reactor was available, a new spinning-electrode concept was developed on the basis of literature and deep electrochemistry expertise, resulting in a 2022 patent application on the novel electrochemical reactor concept. Prototype reactors in several scales were then developed with the support of an aws prototype funding scheme.

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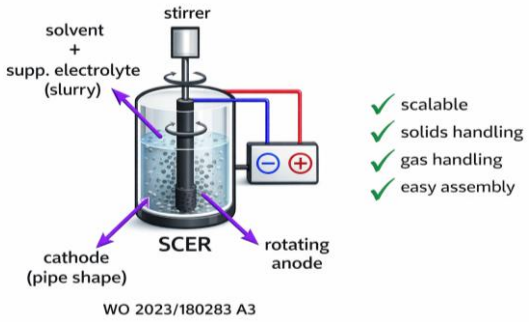
Impact and benefits for research and industry

The new reactor type makes it much easier to transfer electrochemical reactions from the milligram to the multi-hundred-gram range and beyond, without having to redesign the process from scratch each time. The ability to handle solids broadens the design options in synthesis, while improved gas removal increases process safety and supports green-chemistry goals – for example by avoiding stoichiometric oxidants.

The technology forms the basis for the first commercially available spinning-electrode reactor, which will be launched on the market by Merck KGaA, Darmstadt, Germany in the near future. Companies can first establish electrochemical methods on a small and medium scale and, if successful, scale them up together with RCPE GmbH and the University of Graz to larger throughputs. RCPE and the University of Graz retain the rights to the largest reactor type in order to implement tailored scale-up studies and licensing models with industrial partners.



The reactor permits scaling electrochemical transformations from the milligram scale to kilogram quantities without the need for re-optimization of reaction conditions.

Around ten publications with pharmaceutically relevant applications – including collaborations with Merck USA, Pfizer, Eli Lilly and Dr. Reddy's – demonstrate the performance of the reactor concept. This example illustrates how a clearly defined industrial need can lead to a novel, patent-protected technology with a broad application spectrum that finds its way into industrial practice through partnerships with industry.

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