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Advancing electrochemical micromachining technology for new and difficult-to-cut materials

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Electrochemical micromachining (ECM) is a non-contact and athermal process that can machine electrically conductive materials through anodic dissolution in the presence of an electrolyte and applied voltage governed by Faraday's law of electrolysis. The absence of mechanical forces and thermal damage make ECM especially suitable for machining advanced materials, regardless of hardness, while preserving surface and subsurface material properties. This is critical for ensuring functional performance in high-tech sectors such as aerospace, biomedical, MEMS and precision tooling.

At the Micro- & Precision Engineering Group (MPE) at KU Leuven, the research is focused on advancing both tool-based and jet-based ECM process configurations using custom-built and commercial setups for shaping and surface structuring applications. One of the key research tracks is to develop strategies for machining advanced materials with high precision and surface integrity. The team has also developed in-house a novel hybrid laser-electrochemical machining (LECM) technology to deliver coaxial microsecond pulsed-electrochemical and nanosecond pulsed-laser process energies simultaneously to the machining zone, to enhance reaction kinetics, material removal rates, precision and surface quality.

These processes have shown promising results on a range of material classes, including superalloys, cermets/carbides and tool steels. These capabilities make ECM an interesting technology to explore further for machining monocrystalline silicon to support the machining/finishing of the suspension system of the Einstein Telescope.

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