Development of advanced laser processes for multiscale surface modification of functional electrodes in Liquid Chromatography-Mass Spectrometer instrumentation

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The modification of the surface properties, over multiple length scales, of functional engineering components, plays a significant part in optimising their functional performance. The surface chemistry, texture and crystal structure can influence the absorption and electronic properties of the surface, the susceptibility of the surface to wear and damage and the frictional, adhesive and wetting forces acting at a material interface. Therefore, multiscale surface modifications and the techniques available to affect such modifications are critical factors in the development of new functional electrodes in Liquid Chromatography-Mass Spectrometer (LC-MS) instrumentation.

The unique and novel interaction of tailored laser light with a material can lead to permanent changes in a material's surface properties not easily achieved by other means. Laser irradiation has been shown to induce changes to the local chemistry, the local crystal structure and the local morphology, and this is expected to affect how an electrode will behave in an LC-MS application. In particular, short and ultrashort-pulse laser irradiation offers the ability to precisely deposit extremely large peak intensities into a material. Furthermore, very high spatial resolutions on or near the surface can be obtained through controlled laser parameters and using novel optical techniques such as vector field modulation [1,2]. The tailored laser-material interactions lead to extremely accurate control of the local surface properties relative to the bulk and other regions on the surfaces.

The research will present recent results on ultrashort-pulse laser micro-texturing of electrodes and its impact on the electrode performance.

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[2] O.J. Allegre, Z. Li, L. Li, (2019) *Tailored laser vector fields for high-precision micro-manufacturing*, CIRP Annals. 68 pp:193–196