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Tailored ITO deposition at room temperature for optical and electrochemical bio-sensors

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Our work focuses on the investigation of nanostructured surfaces for advanced sensors based on optical fibre. Conventional, fibre sensors utilize concepts of intensity, phase or wavelength modulation. However, our novel approach aims at the development of a fibre sensor that is capable to combine not only the standard optical way of detection but an electrochemical way of detection as well. We used to employ a lossy mode resonance (LMR) effect for optical detection. Furthermore, in our concept, we also utilize the fibre sensor body as an active working electrode in cyclic voltammetry measurements for electrochemical detection. By other words, the surface of the optical fibre needs to be tailored to achieve an LMR effect together with a relevant response for cyclic voltammetry.
The LMR effect occurs when light propagating through the optical fibre core refracts at the film-core interface. The resonance conditions are determined by the layer properties (refractive index, dielectric constant) covering the fibre core and the medium being investigated. On the other hand, the film resistivity and mobility of carriers are the key parameters for the efficient working electrode in cyclic voltammetry. Both parameters can be achieved by tailored indium doped tin oxide (ITO) film deposited onto the bare fibre core.
Hence, the contribution focuses on the characterization of plasma discharge and ITO films deposited by pulsed magnetron sputtering. Optical, electrical and structural properties were tailored as a function of reactive process gases, namely O2 and N2, using optical ellipsometry, UV-VIS, four-point probe method, AFM and XRD. Experiments show that proper introduction of reactive gases into discharge induces crystalline films with various preferred orientations without any post-deposition annealing. Beside film investigation, we carried out cyclic voltammetry and LMR measurements for detection of selected biomolecules.
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Keywords
ITO, Optical fibre, LMR, Electrochemistry, Bio-sensors