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Advanced mesoporous thin film characterisation by ellipsometric porosimetry

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Mesoporous architectures in thin film configurations (< 10 μm) are promising class of materials for a range of applications, including antireflective coatings [1], electrochemical sensors [2], and electrode materials [3] among others. The low quantity of solid contained in such thin films makes their structural characterisation with conventional methods developed for bulk materials (e.g. N2 porosimetry) challenging [4]. Ellipsometric porosimetry (EP) is an alternative, purely optical characterisation technique based on spectroscopic ellipsometry, enabling the study of very thin, porous layers in a non-destructive way through acquiring refractive index, extinction coefficient and thickness information based on the change of polarization of the reflected light. Ellipsometric spectra are acquired at different relative pressures of a gas phase adsorptive to construct a volume adsorbed isotherm via effective medium approximations. Since the characterisation is purely optical without requirement for volumetric or gravimetric information of the adsorptive, the accuracy of measurement is independent of the quantity of the studied adsorbent film, hence reliable information can be obtained for limited sample sizes (in terms of thickness and lateral extension).

In this work, the mesoscale characterisation of porosity, pore size distribution and specific surface area via EP is presented, as well as advanced methods for the investigation of mechanical strength (Young-modulus) [5] and microscopic wettability [6]. A wide range of porous architectures and surface chemistries were explored to provide guidance on the technique's applicability with suitable adsorptives, such as water, toluene, methanol, and other organic liquids.

Participation

In-Person

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