Implementation of electrical resistance tomography for conductivity mapping of nanostructured transparent conductor materials

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Implementation of electrical resistance tomography for conductivity mapping of nanostructured transparent conductor materials

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Abstract

Electrical Resistance Tomography (ERT) is a non-invasive technique that allows to map the conductivity of the interior of an object by performing only boundary transresistance measurements by means of an array of contacts. It is typically implemented injecting a current through pairs of contacts and sensing voltage between other pairs, following a suitable measurement sequence. Numerical methods are used to retrieve the conductivity map of the sample from the set of transresistance measurements. A technique historically developed for clinical applications (in its ac version, impedance tomography), in the last years, ERT has been extended to the characterisation of materials.

In this work, we report on the implementation of ERT for mapping the conductivity of transparent conductive materials (TCM) where homogeneous spatial distribution of conductivity represents a key aspect for their further development. We show that ERT can be successfully exploited for mapping the conductivity of thin-film based transparent conductive oxides [1] and 2D materials like graphene [2]. Also, we show that this technique can be exploited for the characterization of emerging TCM such as metallic NW networks [3]. In this case, a different, more suitable measurement protocol, based on a “voltage-controlled” excitation, has been developed to avoid sample alterations during measurements [4]. By exploiting this approach, spatial mapping of Ag NW network conductivity was demonstrated over a broad nanowire density (60 - 180 mg/m^2) while temporal-dependent mapping allowed monitoring of the network degradation.

Hence we envision that ERT is turning up as a reliable tool for assessing the space-resolved conduction properties of a broad set of emerging TCM and nanomaterials, relevant for further development of transparent conductive materials and electronic devices.

Bibliography

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