Effect of hybrid binder system on the conductive properties of TiO_2:Nb coatings

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INTRODUCTION

Wet chemical deposition of transparent conducting oxides is an alternative to the expensive atmosphere controlled deposition techniques employed in production of electrodes for photovoltaics, displays, touch screen devices and smart windows.

Sol-Gel processes generally disputes preferences with nanoparticulate inks. But the latter has advantages, since it separates the coating process from the particles synthesis and crystalization, allowing for low temperature coatings.

STATE OF THE ART FOR TCO PARTICULATE LOW TEMPERATURE COATINGS

Wet chemically deposited ITO requires a binder system to increase contact between nanoparticles and adhesion to the substrate.

3-(Trimethoxysilyl)propyl methacrylate is employed since its acrylate group is polymerized during UV treatment, reducing the overall coatings volume and improving particle packing, which results in higher conductivities [1,2].

INFINITY APPROACH

- Formulation of In-free TCO inks (ZnO:Al, ZnO:Si and TiO_2:Nb) with already conductive nanoparticles and a specific polymeric binder system to increase their packing under low temperature UV curing that allow for higher flexibility
- Nanoparticle synthesis by the flame spray pyrolysis technique
- Matrix system produced by controlled hydrolisis of metal-organics
- Coating is deposited by direct pattern printing over flexible substrates in roll to roll systems

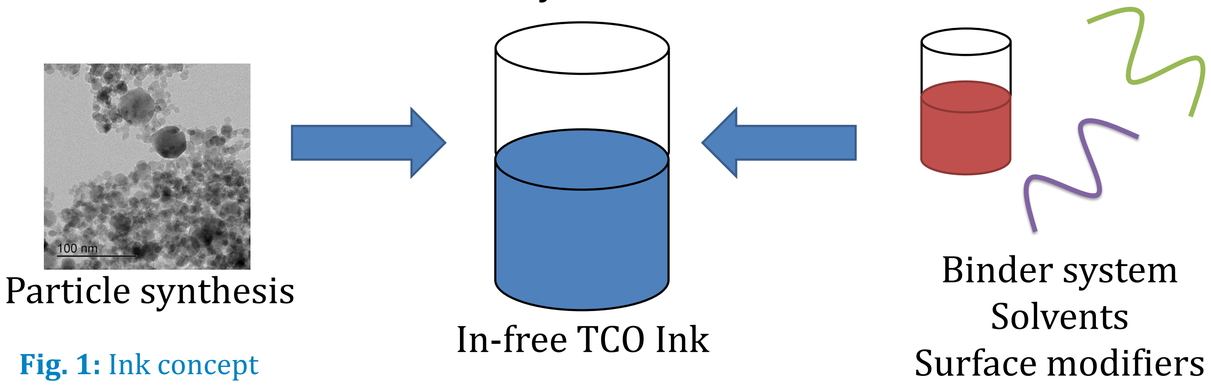

Fig. 1: Ink concept

METHODS

- Inks produced with TiO_2:Nb nanoparticles fabricated by Lurederra with
  - MPTS
  - MPTS+Metalorganic compounds provided by Epivalence[3]→Hybrid binder system
- Spin coating of samples and evaluation of electrical properties with in situ measurement during UV treatment under N_2 atmosphere

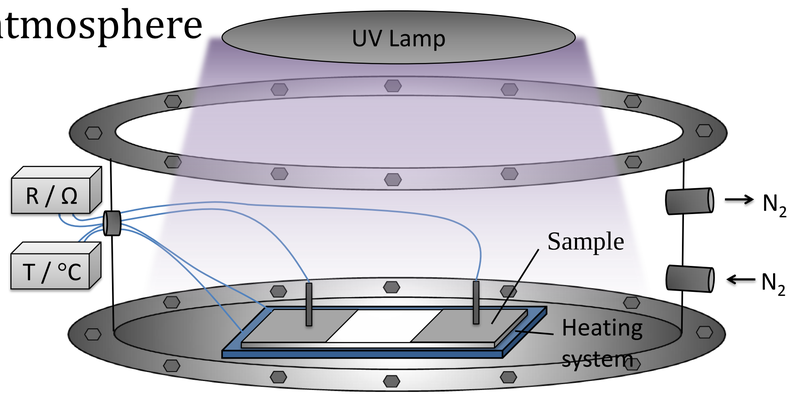

Fig. 2: In situ sheet resistance measurement system during UV treatment

RESULTS

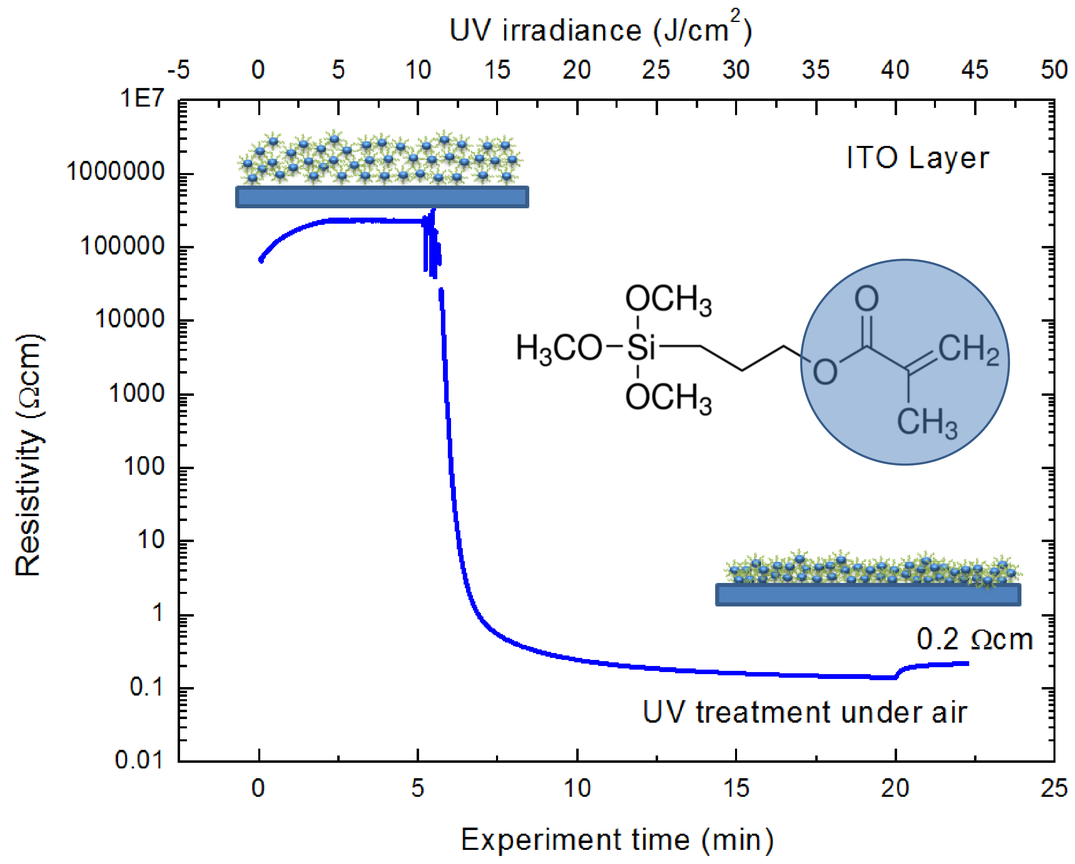

Fig. 1: Resistivity dependence on UV treatment of wet deposited ITO coating

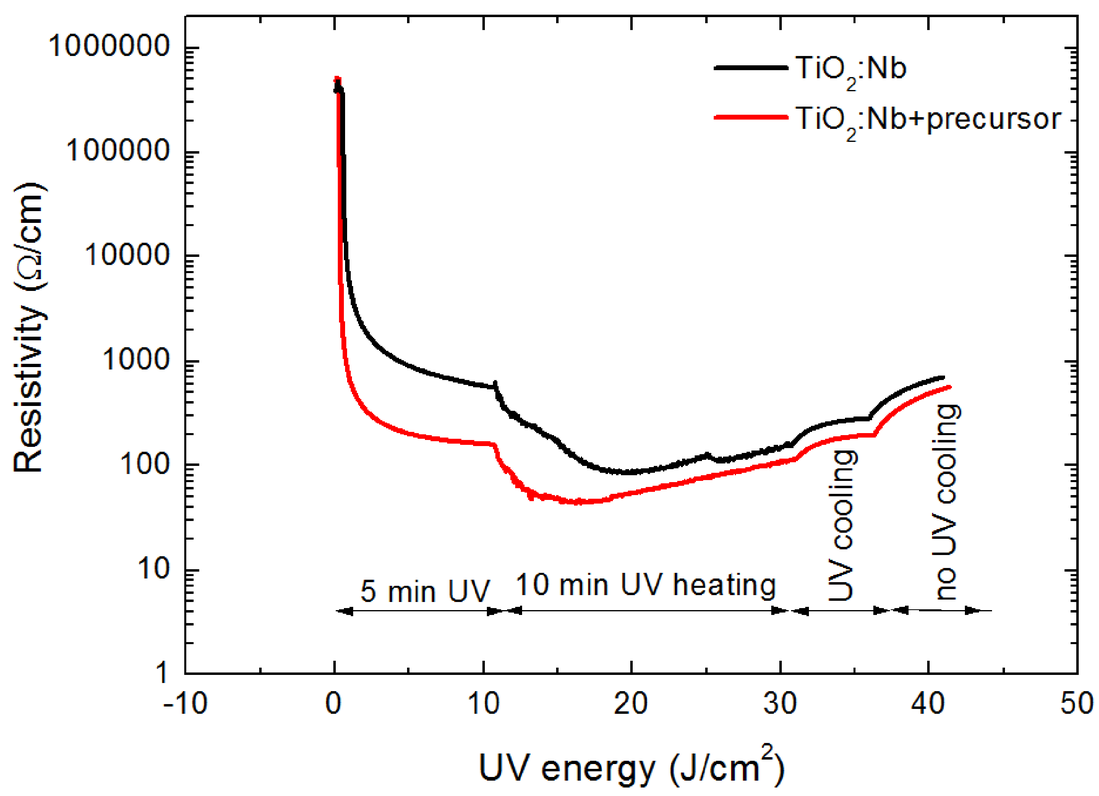

Fig. 4: Resistivity dependence on UV treatment of TiO_2:Nb inks

CONCLUSIONS

- Stable In-free TCO inks could be prepared with a hybrid binder system
- Electrical properties of coatings containning a hybrid binder system were improved in comparison to those of coatings made with the single component MPTS system
- However, the resistivity is still about 3 orders of magnitude higher than that of ITO coatings and still have to be improved.

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