

TUNELLING INDUCED LIGHT GENERATED BY Sb-DOPED TIN OXIDE TIPS.

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Since the invention of STM, several microscopy technologies have been exploited an idea of probing surfaces at nanometre level with sharp "needle". In one of our publications we have outlined a protocol for preparation of novel nanometre level sharp tin oxide fibres by sol-gel technique. For the application in STM this material is interesting because of being both conductive and optically transparent. Therefore, the tip can be used for STM-induced electroluminescence studies without heavily quenching/modifying the optical modes of the sample as it would be the case for metal tips.

Sharp tips were made by breaking jet of prepolymerized tin n-butoxide sol in humid atmosphere followed by aging and baking procedures. The tips of Sb-doped tin oxide were characterized by suitable electrical conductivity and optical transparency (measured from 5.5 to 300K) for using them as sensors for hybrid of scanning tunnelling and near-field optical microscopy (STM/SNOM hybrid).

We explain phenomena of formation of nanometre level sharp fibres with high viscosity gradient during spinning caused by extremely quick formation of gelled layer on the surface of sol jet when pulling it into a humid atmosphere. To improve this method, we have carried out measurements to study how tip characteristics like angle and apex depend on spinning speed of the sol jet, and viscosity of precursor.

To improve suitability of the tips for STM sensors, we debut bulky antimony doped tin oxide STM tips and we tested them on etched gold crystals, getting lateral resolution 1-2 nm. Finally, optical luminescence caused by tunnelling electrons was studied as a function of applied bias voltage as well as simultaneously recording STM topography of ITO films coated by irregular gold islands.

References:

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- [3] K. Nakajima, V. Jacobsen, Y. Yamasaki, J. Noh, D. Fujita, M. Hara, *Japanese Journal of Applied Physics* 41 (2002), p. 4956-4960 (Part 1, No. 7B).

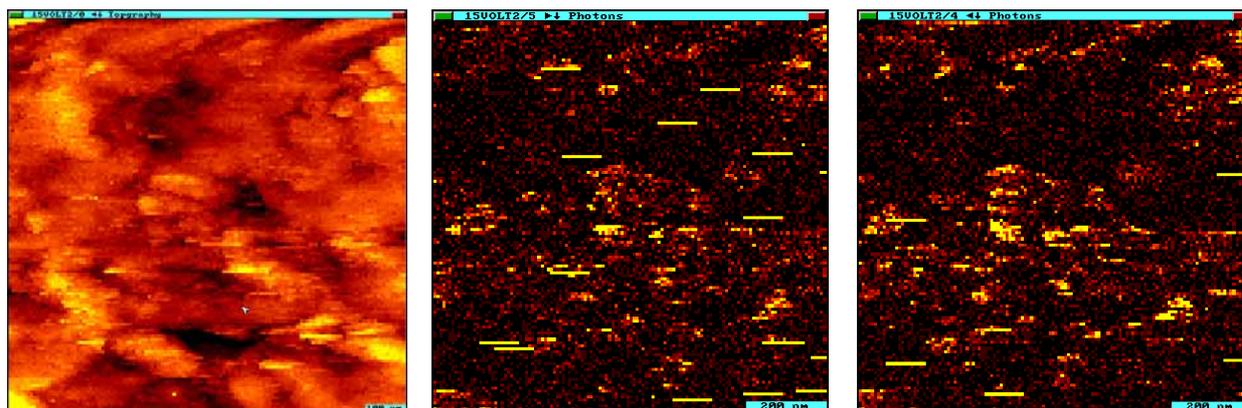
Figures:

Fig 1. STM (left) and tunnelling induced photon images ($1 \times 1 \mu\text{m}^2$) measured by Sb doped tin oxide tip.

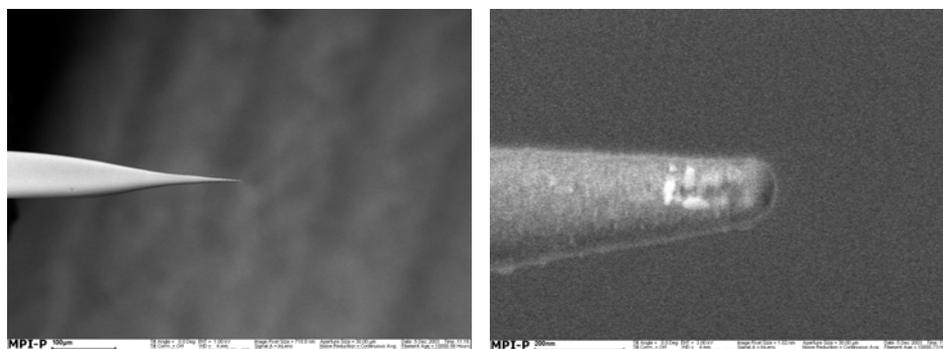


Fig 2. SEM images of typical Sb doped tin oxide tip (scalebars 100 μm and 200 nm).