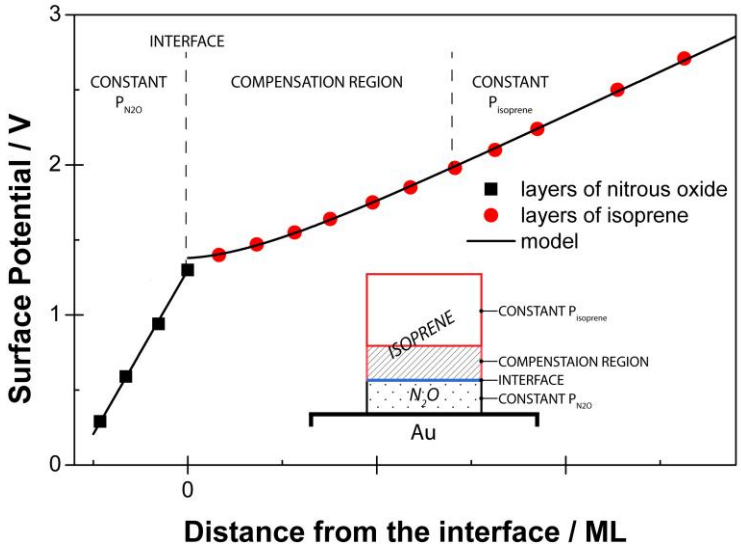
Composite spontelectric films: nanostructured polarized molecular solids

Andrew Cassidy[1], Jack Dunger[1], Oksana Plekan[2], Richard Balog[1], Nykola Jones[1], David Field[1]

[1] *Department of Physics and Astronomy and Institute for Storage Ring Facilities at Aarhus (ISA), Aarhus University, Ny Munkegade, Building 1520, DK 8000, Aarhus C, Denmark*
[2] *Sincrotrone Trieste, S.C.p.A. di Interesse Nazionale, 34149 Basovizza, Trieste, Italy*
amc@phys.au.dk

Spontelectrics represent a class of materials which, when deposited as thin films, spontaneously polarize to produce surface potentials at the film-vacuum interface [1-6]. We show here that we can make electric field nanostructures almost to order using composite films of spontelectric materials. A variety of dipolar molecular species (e.g. nitrous oxide, isoprene, Freons 11,12,13) have been shown to demonstrate the spontelectric effect and fields of > 10^8 V/m have been measured in films of nitrous oxide deposited at 38K. The spontaneous electric fields manifest themselves through the creation of surface potentials at the film-vacuum interface, with the measured surface potential increasing linearly as a function of film thickness. Surface potentials are measured with the SGM2 beamline at the ASTRID synchrotron source (ISA) at Aarhus.

It is possible to layer different spontelectric materials on top of one another, with each material harbouring a different strength or, in some cases, differently oriented, electric field creating any desired electric field structure. Far away from the interface between two materials the upper layer generates a surface potential which increases linearly with film thickness but close to the interface the measured surface potential changes as a function of the distance from that interface. A model is introduced to describe this behaviour.



References:
[1] R. Balog, P. Cicman, N.C. Jones, D. Field, *Phys. Rev. Lett.*, 2009, **102**, 073003
[2] O. Plekan, A. Cassidy, R. Balog, N.C. Jones, D. Field, *Phys. Chem. Chem. Phys.*, 2011, **13**, 21035
[3] D. Field, O. Plekan, A. Cassidy, R. Balog, N.C. Jones, *Europhysics News*, 2011, **42**, 32
[4] O. Plekan, A. Cassidy, R. Balog, N.C. Jones, D. Field, *Phys. Chem. Chem. Phys.*, 2012, **14**, 9972
[5] A. Cassidy, O. Plekan, R. Balog, N.C. Jones, D. Field, *Phys. Chem. Chem. Phys.*, 2013, **15**, 108
[6] D. Field, O. Plekan, A. Cassidy, R. Balog, N.C. Jones, J. Dunger. *Int.Rev.Phys.Chem.* 2013
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