Nano-Imaging: From Science to Technology

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Nanoscience by itself is to a large extent an imaging science where complex information about ultimately small pieces of matter is mapped into multi dimensional arrays. Nano-imaging goes far beyond microscopic projection images and has contributed to the evolution of mankind's scientific understanding which is continuously rolling over into technology. In this talk I will first use nano-imaging to explain some of the recent breakthroughs in nanoscience before I describe selected examples for the transfer of nano-science into nano-technology; All—of course—in the context of imaging. I will close with a rather personal outlook into future developments and long term visions.

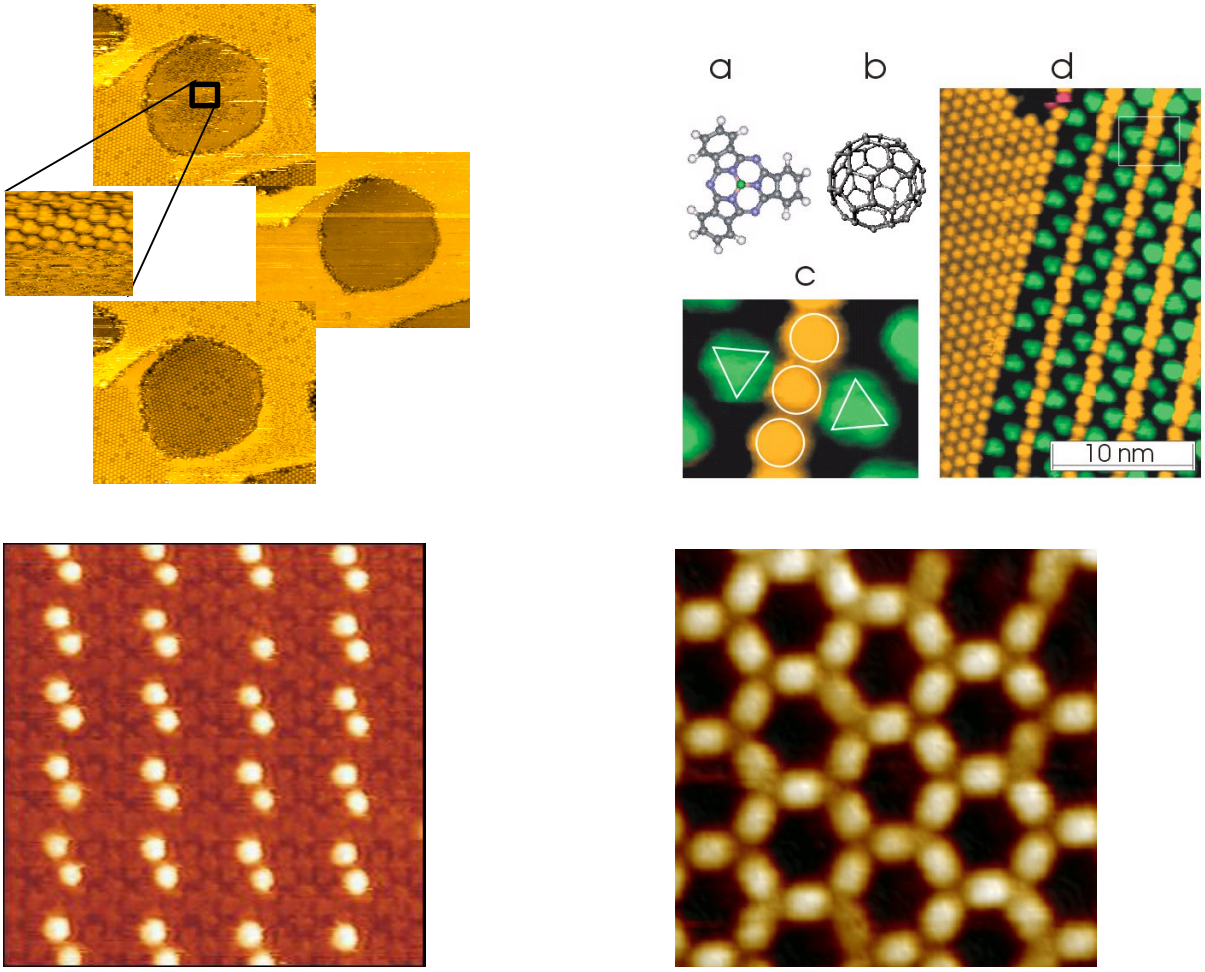

***Figure 1a).**: Phase transition reversibly triggered by the tip of an STM: STM images of SubPc/Ag(111) in a vacancy island of monatomic height. a) overview of liquid phase (no order). During scan in a small subregion (b), the molecules order in an hcp pattern (c), while scanning at negative bias (d) erases the structure resulting again in the fluid phase (as a). Tunnel parameters: a), c) 90 nm x 90 nm, I=10 pA, U=1,2 V, b) 11 nm x 11 nm, I=10pA, U=1,2 V, d) 90 nm x 90 nm, I=10 pA, U= -1,2V. All images were acquired by scanning from bottom to top. [1] **Fig. 1b)**: Self-intermixed phases **a**: Structure of SubPc. **b**. Structure of C_{60}. **c**: Artificially coloured STM image of the basic unit of the molecular chain pattern with superimposed schematic shapes (SubPc green, C_{60} yellow). **d**: Artificially coloured STM image of a monolayer of intermixed molecules on Ag(111). On the left hand side, close packed C60 overlayers are recognised (imaged area, 17 x 25 nm). The bare substrate areas appear dark. **e**: Coexistence of two different intermixed patterns, labelled I and II (image area, 34 x 34 nm). On the right hand side, the chain phase (I) and on the left hand side, the hexagonal phase (II) is observed. Random tip excursions of single molecular height (III) are visible between the two ordered regions and are identified as mobile molecules in a 2D gas phase [2]. **Fig .1c)** Supramolecular patterned surface by cooperative self assembly of C60 and a Porphyrin. Individual C60 are visible in the second molecular ad-layer. The affinity of the C60 to the underlying porphyrin layer is governed by a cooperative mechanism which involves conformational flexure.[3]. **Fig. 1d)** Oligo-perylene Network which is fomed by a dedicated covalent reaction activated at elevated Temperatures after molecular adsorption. Hexagonal pockets allow for novel functional properties.[4]*

References

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Author Biography

Dr. Jung is a research group leader at the Paul Scherrer Institute (PSI), which is a member institution of the domain of the Federal Institute of Technology. Here he is working in the field of nanometer-scale science and technology in particular nanomechanics, molecular switching and molecular nanoscale devices. Since 1999 he also heads the 'Nanolab' at the University of Basel where he gives lectures and supervises students and postdocs.

He joined the IBM T.J. Watson Research Laboratory as a Post Doctoral Fellow in 1992 to work on Scanning Tunnelling Microscopy and Spectroscopy of metallic wires and islands. Between 1994 and 1997 he explored interfaced molecular nanostructures while working at IBM's Zurich Research Laboratory in Rüschlikon, Switzerland. Here molecular positioning was achieved for the first time at room temperature and unique methods for the identification and analysis of an individual molecules' conformation were demonstrated.

Dr. Jung received a Diplom degree in solid state physics and biophysics from the Swiss Federal Institute of Technology in 1987 and a PhD in solid state physics and surface physics from the University of Basel, Switzerland, in 1992.