June, 10th 2025 – 10:10

Seminar room, DFA

Scientific Seminar

Manipulating Metal Atoms and Manufacturing Atomic Clusters

Richard E Palmer

Nanomaterials Lab, Swansea University, Bay Campus, Swansea SA1 8EN, UK

"But I am not afraid to consider the final question as to whether, ultimately - in the great future - we can arrange the atoms the way we want; the very atoms, all the way down! What would the properties of materials be if we could really arrange the atoms the way we want them? They would be very interesting to investigate theoretically. I can't see exactly what would happen, but I can hardly doubt that when we have some control of the arrangement of things on a small scale we will get an enormously greater range of possible properties that substances can have, and of different things that we can do".

So wrote Feynman in 1959 and the words are so remarkable you never tire of reading them. In fact it was Don Eigler, with his manipulation of atoms in the STM in 1990, that made this quotation famous. Yet the nanocluster approach competes favourably in the quest for atomic manufacturing, i.e., of « arranging the atoms, and at scale ». It is much more scalable than STM – various labs are now envisaging cluster deposition at the gram and even kg scale, suggesting real industrial possibilities. And nanoalloys offer even more scope.

In this talk I will survey some recent advances in atomic cluster manufacturing – as enabled by new experimental production methods and probed by state-of-the-art measurement techniques, like variable-temperature, aberration-corrected electron microscopy. The emphasis will be on clusters of noble metal atoms like Au and Pt on surfaces [1,2].

Together the measurements provide a snapshot of the progress towards realizing Feynman's vision in the world of clusters and nanoalloys.

[1] M. Dearg, et al, Nanoscale Horizons 9, 143 (2024).

[2] H. Eliasson, et al, Nanoscale 15 19091 (2023).

Richard Palmer is Head of the Nanomaterials Lab at Swansea University, UK, in his hometown, Swansea. He is also Professor, School of Physics, Nanjing University, China. His research on atomic clusters includes fundamental studies of atomic structure and dynamics as well as scale-up and applications in catalysis, energy and biomedicine. Other well-established research themes include atomic manipulation in STM and semiconductor nanofabrication.

Richard was awarded an MA and PhD at Cambridge University where he also held 1851, Clare College and Royal Society Fellowships. At Birmingham he founded the UK's first centre for nanoscience. Honours include: IOP Boys Medal; Honorary Doctorate from Hasselt University, Belgium; British Vacuum Council Yarwood Medal; EPSRC Senior Fellowship; and Fellowships of IOP, RSC, Learned Society of Wales. He has >500 publications, h = 68, and >20 families of patent applications. His work has led to a series of spin-out companies including Inanovate, Irresistible, Nium and Grove Nanomaterials (Founder and CEO since 2023). He is founding Editor-in-Chief of the journal Advances in Physics: X (Taylor and Francis) and Editor of the Elsevier Book Series 'Frontiers of Nanoscience'.

For info: prof. **M. Chiara SPADARO**, e-mail: mariachiara.spadaro@dfa.unict.it

Dr. **Vincenzina Strano**, e-mail: vincenzina.strano@cnr.it