Innovation in Materials and Soft X-ray Analytics: From Qu...

MRM2023/IUMRS-ICA2023 Grand Meeting
December 11-16, 2023, Kyoto, Japan

[Abstract Guideline (Leave two lines for presentation number)]

Innovation in Materials and Soft X-ray Analytics: From Quantum to Networked

*Kai Rossnagel[1,2]
[1] Institute of Experimental and Applied Physics and KiNSIS, Kiel University, 24098 Kiel, Germany
[2] Ruprecht Haensel Laboratory, Deutsches Elektronen-Synchrotron DESY, 22607 Hamburg, Germany
*rossnagel@physik.uni-kiel.de
Keywords: Quantum materials, networked matter, soft x-ray spectroscopy, ARPES, innovation.

Without materials, there is nothing. Without quantum materials, there is nothing interesting. And without networked materials, there is nothing intelligent (in material function).

Quantum materials express our desire to find and explain new physical phenomena, while networked materials represent the ultimate integration of materials into dynamic physical and biological networks. With the power of the quantum and the adaptability of the network, these two classes of materials offer endless research opportunities, hold great technological potential, and together open up a future of sustainable possibilities.

But these materials aren't just fascinating in themselves; they're also driving advances in the tools we use to understand them. To effectively engineer quantum and networked materials, we need to see their inner workings and how they interact with their environment at the atomic level. In particular, soft x-ray spectroscopy has emerged as an indispensable toolkit for probing the behavior of the active electrons. At the forefront of this analytical arsenal is angle-resolved photoelectron spectroscopy (ARPES), which has become the powerful standard technique for imaging the momentum-dependent electronic structure of materials and interfaces. Excitingly, ARPES has recently been transformed into a genuinely *in operando* technique, enabled by the use of nanofocused and ultrashort-pulsed soft x-ray beams to directly probe nonequilibrium electronic function on nanometer and femtosecond scales.

Here, we present recent innovations in quantum materials and electronic imaging, and introduce the concept of networked matter. Our focus is on designer quantum materials within the transition-metal dichalcogenide family, offering a glimpse into the exciting future of materials physics.