H2020 Project Fundamental Breakthrough in Detection of Atmospheric Free Radicals (RADICAL)

Abstract

The central aim of RADICAL is to deliver the science and technology for the selective trapping of atmospheric hydroxyl (·OH) and nitrate (·NO3) free radicals on the surface of silicon (Si) nanowires (NWs) for their electrical detection and quantification. This new approach is based around innovative functionalisation methods of Si NWs and novel Si junctionless nanowire transistors (JNTs), which have the potential for cheap mass production. Thus, the major scientific breakthrough of the project is the paradigm shift in the detection of short-lived atmospheric radicals from the presently used complex, expensive and highly specialized spectroscopic and mass spectrometric techniques to new, low-cost, small and easy-to-use nanoelectronic devices.

Three breakthrough science and technology targets have been identified: 1) fabrication and functionalisation of arrays of Si JNTs for the selective and highly sensitive electrical detection of ·OH and ·NO3 radicals, 2) real-time electrical detection of ·OH and ·NO3 radicals using functionalized JNT devices under a range of laboratory conditions and 3) evaluation and validation of the radical detectors under realistic conditions in highly equipped atmospheric simulation chambers and via deployment in the ambient atmosphere.

Extensive expertise in advanced electronics, computer modelling, materials and surface science, nanofabrication, radical chemistry, physics, machine learning and atmospheric science is integrated on a pan-European level to achieve the project objectives, the ambitious breakthrough targets and the overall aim of the project. This knowledge developed in RADICAL has the potential to bring about a dramatic breakthrough in air quality and climate monitoring and control, leading to benefits for the health of citizens and society as a whole.

The tasks of the Institute of Ion Beam Physics and Materials Research at the Helmholtz Centre Dresden-Rossendorf (HZDR) are in the fabrication and characterization of Si JNTs as well as in their application as radical sensors.