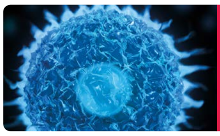

Source: istockphoto.com

ADVANCED MATERIALS SCIENCE

Fields of Expertise TU Graz

Peter Hadley,
Advanced Materials Science
Source: Lunghammer – TU Graz

Our understanding of solids is largely based on studies of ordered materials where the atoms are arranged in straight rows. However, many engineering materials are composites with a high degree of disorder and sometimes a fractal or hierarchical structure. To be able to examine complex materials like this, a consortium of nine institutes from four TU Graz faculties and three institutes from the University of Graz and Med Uni Graz joined together to acquire a µCT instrument with the Austrian Research Promotion Agency (FFG) funding, awarded under its recent infrastructure call. This instrument uses X-rays to determine the microscopic structure and composition of a material. The machine uses a combination of X-ray imaging and X-ray diffraction. X-ray imaging involves measuring the intensity of X-rays that pass through a sample. This produces images like the ones conventionally used in hospitals. By taking X-ray images from a number of different angles, it is possible to make a 3D reconstruction of an object. This method is called computed tomography (CT). A µCT performs computed tomography with a spatial resolution in excess of one micron. X-ray diffraction can be used to determine which atoms are present in a crystal, the arrangement of the atoms, and the distances between the atoms. For instance, the double helix structure of DNA was first determined by crystallising DNA and measuring it by X-ray diffraction. Conventionally, X-ray diffraction has been performed on single crystal samples but the latest µCT devices can focus the X-rays on a small region, and determine how the atoms in that region are arranged. A similar measurement is sometimes performed using an intensely focused X-ray nanobeam in a synchrotron. Once the 3D structure of a material has been determined by µCT, a lot of computational work is still necessary to segment the different components of the material and determine how they are connected together. For instance, a porous material might consist largely of parallel channels or the channels might be twisted with many dead ends. The µCT will be maintained by a senior scientist, who will assist the institutes with programming data analysis routines and travel with them to synchrotrons when additional experiments using a nanobeam are necessary.

Alicja Michalowska-Forsyth,
Varvara Bezhenova:

Radiation Damage in Microelectronics

Reliability is a wide-ranging subject in microelectronics, covering responses to different kinds of stress as well as measures to increase devices' tolerance against them. This includes ionising radiation stress, which affects device characteristics, leading to circuit degradation. Investigating such problems, as well as irradiation campaigns with custom integrated circuits (ICs) are the day-to-day focus of the team at the Institute of Electronics.

Analog IC design is an integral part of microelectronics. Designers have a host of options when it comes to meeting specifications, they need to make decisions on trade-offs between different parameters, and also need to comply with strict requirements in terms of precision, fast timing and low noise. It becomes even more challenging when reliability issues, such as ionising radiation stress, come into play.

It is this combination that makes research into radiation-hard integrated circuit design so exciting. Ionising radiation changes the electrical characteristics of microelectronic devices. As a consequence, instruments for medical and industrial X-ray imaging, space or high-energy physics have to be qualified and potentially hardened against ionising radiation. >