#00945

Synchrotron radiation as a probe for structural, elemental and chemical properties of melanosomes

T. Gorniak [1], T. Haraszti [2], M. Anderson [3], M. Grunze [2], A. Rosenhahn [1].

[1]KIT, Institute for Functional Interfaces - Eggenstein-Leopoldshafen (Germany), [2]Applied Physical Chemistry, Ruprecht-Karls-University Heidelberg - Heidelberg (Germany), [3]Department of Molecular Physiology and Biophysics, The University of Iowa - Iowa City (United states).

It is of tremendous scientific interest whether the ultrastructure of melanosomes [1], organelles found in the iris cells, is connected with the development of glaucoma, a disease in which the optic nerve suffers damage. The name of these intracellular, membrane bound organelles is derived from the chemical substance they produce and store: melanin [2]. On the one hand, melanosomes are beneficial as they provide photoprotection to the human body and are responsible for the colour of hair, skin and iris. On the other hand a disorder of their functionality is potentially harmful, resulting in an elevated (10 – 50 fold) risk of skin cancer or, in the eye, in the development of glaucoma. The detailed processes and mechanisms of failure are still unknown. However, it is believed that toxic chemical components and proteins, which are part of the organelle's synthesis of melanin [3,4] leach into the surrounding tissue and cause damage to vital cells, when the function of metabolization or containment of the cytotoxic substances is disturbed. We aim to determine if the granularity of the melanosome's internal ultrastructure develops differently for healthy mice and those with a genetic disposition to develop glaucoma. A structural change of the organelles could point towards a disturbed encapsulation of cytotoxic substances and thus play a key role in the development of diseases of pigmented tissue. Since melanin is an exceptionally dense material – making it challenging to probe the melanosomes' ultrastructure with methods like transmission electron microscopy (TEM) – the unperturbed morphology of these organelles is still unknown. In our approach, which relies on hard X-rays with a high penetration depth, melanosomes are characterized by small-angle X-ray scattering (SAXS) and these diffraction fingerprints are correlated with the genetic background to identify possible differences. We supplement the results from these experiments with data from complementary techniques – namely soft X-ray tomography and NEXAFS spectroscopy [5] – in order to obtain a broader picture allowing for conclusions relevant for an improved treatment of glaucoma

[1] Anderson, M.G. et al., Nature Genetics 30, 81-85 (2001).
[2] Riley, P.A., The International Journal of Biochemistry & Cell Biology 29, 1235–1239 (2003).
[3] Pawelek, J.M. et al., Nature 627–628 (1978).
[4] Creveling, C.R., 266 (F P Graham Company: 2000).
[5] Haraszti, T. et al., Pigment Cell & Melanoma Research 24, 187–196 (2010).