Poster Presentations

[MS14-P03] Symmetry Breakings in Aperiodic Composite Crystals. Céline Mariette,[a] Bertrand Toudic,[a] Philippe Rabiller,[a] Laurent Guérin,[a] Alexey Bosak,[b]

[a] *Institut de Physique de Rennes, France,* [b]*European Synchrotron Radiation Source, Grenoble, France*
E-mail: celine.mariette@univ-rennes1.fr

Aperiodic crystals have the property to possess long range order without translational symmetry. These crystals are described within the formalism of superspace crystallography [1-4]. Aperiodicity in composite materials may appear rather naturally
due to the possible misfit of host and guest parameters along their crystallographic directions. A huge simplification exists in one dimensional (1D) composite aperiodic crystals since the co- linearity of the incommensurate vectors is always
maintained allowing a definite assignment of all the diffraction Bragg peaks. Urea inclusion compounds (UIC) constitute such a family of molecular composite structures, where long-chain guest molecules are embedded in parallel channels of the host urea sublattice and among them, most of the n- alkane UIC are incommensurate [5]. In this contribution, we will focus on symmetry breakings which take place in such crystallographic
superspace groups, considering this prototype family. Studies performed by X-ray diffraction using synchrotron sources reveal multiple structural solutions implying or not changes of the dimension of the superspace. Most fascinating ones concern phase transitions which increase the dimension of the crystallographic superspace [6-8]. We will present the characterization of the order parameter and of the critical pretransitionnal phenomena associated to these phase transitions of group/subgroup types. Anomalously large correlation lengths are reported along the incommensurate direction [9]. This symmetry breaking which double only the internal dimension of the crystallographic superspace could be interpreted as resulting of the softening of a phason branch. The specific excitations of aperiodic
crystals such as phasons can be directly observed and analyzed by coherent neutron and inelastic X- ray scattering. Such measurements performed on *n*- nonadecane/urea revealed the coupling of the phason and the acoustic modes polarized along the
incommensurate direction [10]. Recent studies done in the reciprocal space close to internal vectors of the superspace evidenced a low frequency damped excitation that we tentatively interpret as the sliding mode of this composite.

[1] T. Janssen, A. Janner, A. Looijenga-Vos, and P. M. de
Wolff, in International Tables for Crystallography (IUCR, Kluwer Academic, Dordrecht, 2006), p. 907.

[2] T. Janssen, G. Chapuis and M. de Boissieu, Aperiodic Crystals, From modulated phases to quasicrystals, Oxford science publication, International Union of crystallography (2007).

[3] S. van Smaalen, Incommensurate Crystallography
(Oxford University Press, Oxford, 2007).

[4] J. M. Perez-Mato, in Methods of Structural Analysis of Modulated Structures and Quasicrystals, World Scientific Publishing, Singapore (1991).

[5] M. D. Hollingsworth and K. D. M. Harris, in Comprehensive Supramolecular Chemistry, edited by D. D. MacNicol, F. Toda, and R. Bishop (Elsevier, Oxford,
1996), p. 177.

[6] B. Toudic, P. Garcia, C. Odin, P. Rabiller, C. Ecolivet, E. Collet, P. Bourges, G. J. McIntyre, M. D. Hollingsworth, and T. Breczewski, Science 319, 69 (2008).

[7] B. Toudic, P. Rabiller, L. Bourgeois, M. Huard, C. Ecolivet, G. J. McIntyre, P. Bourges, T. Breczewski, and T. Janssen, Europhys. Lett. 93, 16003 (2011).

[8] M. Huard, B. Toudic, P. Rabiller, C. Ecolivet, L. Guérin, P. Bourges, T. Breczewski, and M. D. Hollingsworth, J. Chem. Phys. 135, 204505 (2011).
[9] C. Mariette, L. Guérin, P. Rabiller, et al., Phys. Rev. B87, p. 104101 (2013)
[10] B. Toudic, R. Lefort, C. Ecolivet, et al., Phys. Rev. Lett. 107, p. 205502 (2011)

Keywords: aperiodic composite, phase transitions, dynamics