MS33. Mechanical effects and properties of ordered matter

Chairs: Panče Naumov, Helena Shepherd

MS33-O1 Photomechanical effects in crystals: the role of temperature. A case study of linkage isomerization in $[Co(NH_3)_5NO_2]Cl(NO_3)$

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The research on mechanically responsive single crystals had developed and was very active back in the 1980s. Dating just back over a decade, this field was revived alongside the growing realization that the mechanical effects in crystals can be utilized as dynamic elements in macroscopic devices, and several research groups have been particularly prolific in this research field [1]. One of the issues when studying these transformations is to correlate the degree of nitro-nitrito phototransformation and the macroscopic mechanical response. In an early study of our group we have proposed to use the quantitative measurements of the elastic bending of needle-shaped crystals of $[Co(NH_3)_5NO_2]Cl(NO_3)$ on irradiation to follow the kinetics of the transformation and the effect of the elastic compression on the quantum yield [2-6]. We have now revisited this system and have modified the experiment design, in order to follow the effects of temperature in the range from 100 K to 400 K on the transformation. This made it possible to follow the role of temperature in the photomechanical effect, taking into account both the lattice strain related to the anisotropic thermal expansion and the reverse nitrito-nitro isomerization (studied by variable-temperature single-crystal X-ray diffraction). A direct experimental evidence of the feed-back arising on photochemical nitro-nitrito and on reverse thermal nitrito-nitro isomerization was obtained. The study can be considered as a case study, representative for any photoinduced transformation induced in needle-like crystals when irradiated from one side (i.e. with a gradient of transformation degree normal to the surface).

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1. Nath N.K., Panda M.K., Sahoo S.C., Naumov P. CrystEngComm, 2014, 16, 1850-1858.

2. Boldyreva E.V., Sidelnikov A.A., Chupakhin A.P., Lyakhov N.Z., Boldyrev V.V., Proceed. Acad. Sci. USSR 1984, 277, 893-896.

3. Boldyreva E.V., Sidelnikov A.A. Proceed. SB USSR, Chem. Sci., 1987, 5, 139-145.

4. Yakobson B.I., Boldyreva E.V., Sidelnikov A.A. Proceed. SB USSR, Chem. Sci., 1989, 1, 6-10.

5. Boldyreva E.V., Mol. Cryst. Liq. Cryst. Inc. Non-Lin. Opt. 1994, 242, 17-52.

6. Boldyreva E.V. Coord. Chem. Russ., 2001, 27(5), 323-350.

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