THERMAL EXPANSION ANOMALIES AT A QUADRUPOLAR ORDERING IN $DyVO_4$

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9.7 cm

The thermal expansion anomalies in $DyVO_4$ at a spontaneous ordering of the quadrupolar moments of Dy^{3+} ions are studied both experimentally, with the help of glued strain gauges and a capacitive deformation sensor, and theoretically. Characteristic anomalies in the unit cell parameters $\Delta a/a(T)$, $\Delta b/b(T)$ and $\Delta c/c(T)$ as well as in the $\Delta a'/a'$ curve along the non active Jahn Teller direction are revealed for $T < T_c$=14 K. Within the general crystal-field approach the magnetoelastic contributions to $\Delta a/a$, $\Delta b/b$, $\Delta c/c$ and $\Delta a'/a'$ both from the dominated Jahn-Teller modes ϵ^γ and totally symmetric modes $\epsilon^{\alpha 1}$ and $\epsilon^{\alpha 2}$ are calculated. The contributions of the totally symmetric modes, proportional to the quadrupole moment $< O_2^0 >$, result in observable magnetoelastic effects, in particular in the tetragonal and volume deformations, and its calculation has required taking into account all the details of the crystal field. The values of magnetoelastic B^γ and total quadrupolar G^γ coefficients are determined, From the data on spontaneous deformations and spectroscopy the contribution of the pair quadrupolar interactions K^γ to the G^γ being positive. It is shown that the thermal expansion of $DyVO_4$, both in tetragonal and orthorhombic phases, is well described by a common model using a single set of interaction parameters.

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