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Far infrared non-reciprocal directional dichroism reveals ferrotoroidic order in $LiCoPO_4$[1] URMAS NAGEL, T. RÕÕM, Natl Inst of Chem Phy Bio, Tallinn, Estonia, I. KÉZSMÁRKI, S. BORDÁCS, Budapest University of Technology and Economics, Hungary, V. KOCSIS, Y. TOKUNAGA, Y. TAGUCHI, Y. TOKURA, RIKEN Center for Emergent Matter Science, Japan — Non-reciprocal dichroism means that counter-propagating light beams experience different indexes of refraction. This phenomenon, which has been exclusively observed in non-centrosymmetric (polar or chiral) materials with finite magnetization, is the consequence of the dynamic magnetoelectric effect in materials with simultaneously broken time reversal and spatial inversion symmetries. We show that $LiCoPO_4$ with a fully compensated antiferromagnetic ground state, i.e. with zero net magnetization, can also exhibit unidirectional transmission. Following an appropriate magnetoelectric poling in crossed electric and magnetic fields, we succeeded to realize the unidirectional transmission as a remnant effect in this compound. The unidirectional transmission likely originates from a ferrotoroidic order which can be viewed as the cross-product of antiferroelectricity and antiferromagnetism coexisting in $LiCoPO_4$. The sign of the magnetoelectric effect can be set by the poling electric and magnetic fields via the establishment of mono-domain ferrotoroidic states.

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