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Terahertz electromagnons in spin-diluted cupric oxide: dynamics of twisted spin states JAMES LLOYD-HUGHES, University of Warwick, SAMUEL JONES, University of Oxford, NICOLA WURZ, MICHELE FAILLA, CHRIS MCCONVILLE, University of Warwick, DHARMALINGHAM PRABHAKARAN, University of Oxford — Understanding the physics of magnetoelectric materials may lead to their application in actuators, sensors and solid state memories. Improper multiferroics also have novel quasiparticle excitations: electromagnons form when spin-waves become electric-dipole active. We investigated magnons, electromagnons and spin-lattice coupling in Cu(1-x)Zn(x)O ($0<x<0.05$), an improper ferroelectric. Terahertz time-domain spectroscopy demonstrated electromagnons only in the multiferroic phase, and established the selection rule and that the oscillator strength tracks the static polarisation [1]. The impact of non-magnetic Zn-substitution on lattice dynamics was elucidated by Raman and Fourier-transform spectroscopy, showing strong spin-lattice coupling in Cu(1-x)Zn(x)O. While the phonon and magnon modes broaden and shift as a result of alloy-induced disorder, the electromagnon was found to be insensitive to Zn substitution and the induced disorder in the local spin structure. The results demonstrate that electromagnon excitations and dynamic magnetoelectric coupling can be maintained even in disordered spin systems, and at elevated temperatures [2]. [1] Nature Communications 5, 3787 (2014). [2] Physical Review B 90, 064405 (2014).

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