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Fabrication and Funcntionality of Complex Oxide Superlattices[1]

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In this talk, we focus on three-constituent magnetic oxide superlattice ('tricolor' superlattice), where the asymmetric stacking like $\cdot\cdot$ ABCABC $\cdot\cdot$ artificially breaks the space-inversion symmetry. The purpose of the study is to realize artificial polar ferromagnets. The polar/noncentrosymmetric magnets, represented by multiferroic compounds, recently attract a considerable interest, because we can expect novel phenomena, such as magneto-electric (ME) effect, or magnetization-induced second harmonic generation (MSHG). In the artificial superlattice, the gigantic MSHG was first realized with a 'tricolor' consisting of a ferromagnet $La_{0.6}Sr_{0.4}MnO_3$ and band insulators $LaAlO_3$ (LAO) and $SrTiO_3$ [H. Yamada, *et al.*, APL **81**, 4793 (2002), Y. Ogawa, *et al.*, PRL **90**, 217403 (2003)]. From the temperature dependence of MSHG in this superlattice, we found that the MSHG originate from the interface magnetism. By utilizing the MSHG as a probe for interface magnetism, we optimized the various oxide interfaces, leading to the discoveries of huge tunneling magnetoresistance in a junction with engineered interfaces [H. Yamada *et al.*, Science **305**, 646 (2004)], or enhanced optical ME effect in the 'tricolor' superlattice composed of $LaMnO_3$, $SrMnO_3$ and LAO. In those functionalities, crucial roles are played by the interface effects characteristic of correlated electron oxides, such as charge transfer or orbital-state-mediated magnetism [H. Yamada, et al., APL**89**, 052506 (2006)].

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