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Controlling physical parameters of layer-structured nitride-halide superconductors[1]

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Metal-intercalation into band insulators sometimes affords superconductors, well-known examples of which are carbon-based materials, such as fullerides and graphite. Layer-structured nitride-halide Li_xZrNCl and Li_xM_yHfNCl (M denotes molecule) belong to another class of intercalation-induced superconductors with relatively high T_c, in which doping level and interlayer distance (and hence interlayer hopping interaction) can independently be controlled by changing Li concentration and the size of the co- intercalated molecule. The controllability provides a unique and interesting opportunity to investigate the effect of the two important physical parameters on T_c in a single system. Recent progress in the synthesis technique enabled us to obtain for the first time a series of single-phase samples of Li_xZrNCl with finely controlled doping-levels which were notoriously difficult to prepare. Using these samples, we have established[1] an electronic phase diagram to find anomalous doping evolution of T_c, which takes a maximum value on the verge of superconductor- insulator transition. Based on this phase diagram and the results of systematic Raman scattering and transport measurements, we will discuss possible roles in producing relatively high T_c played by charge fluctuation and reduced disorder scattering in the layered structure reminiscent of modulation-doped semiconductors. We will also briefly refer to our very recent results on the Hf-based materials in which both of the doping level and interlayer distance were varied.

[1] Y. Taguchi *et al.*, Phys. Rev. Lett. **97**, 107001 (2006)

[1]This work was done in collaboration with A. Kitora, T. Takano, and Y. Iwasa at IMR, Tohoku University.