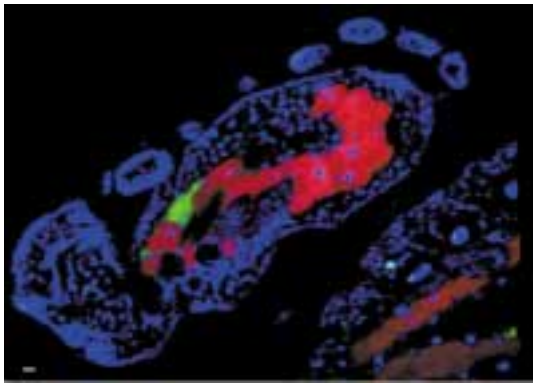
Diversity of Unseen Microbes on the Earth

It is well recognized that uncultured or uncultivable microbes account for more than 99% of total microbes existing in environment, hence, it would be impossible to overview the microbial world by conventional methods in microbiology. We are analyzing diversity of microorganisms in natural and engineered ecosystems using molecular approaches and histological methods. We are also attempting to cultivate microbes yet-to-be-cultured by classical methods combined with new techniques to uncover the unseen majority on the earth.



Endosymbiotic system of the pea aphid, *Acyrthosiphon pisum*. Fluorescence imaging of the endosymbiotic system in an aphid embryo. Host cells are visualized in blue, and the primary and secondary endosymbiotic bacteria are stained in red and green, respectively. The histological technique enables us to investigate spatio-temporal distribution and population dynamics of the endosymbionts in vivo.

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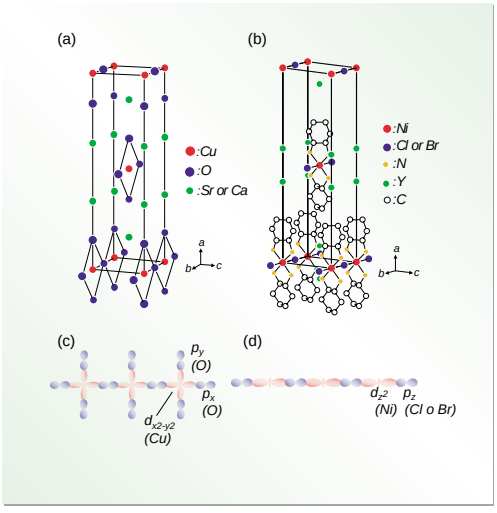
Correlated Electron Optoelectronics

Strongly correlated electron materials, which show interesting transport and magnetic properties such as high-T_c superconductivity or colossal magnetoresistance, are also promissing for optoelectronics materials. Large third order optical nonlinearity ($c^{(3)}$ ~10^{-5}-10^{-8} esu) and ultrafast ground state recovery (~ 2 ps) are observed in one-dimensional copper oxides and halogen-bridged nickel compounds. In these materials, existence of nearly degenerate and spatially overlapped excited states enhances optical nonlinearity. In a layered manganite $La_{0.5}Sr_{1.5}MnO_4$, on the other hand, optical anisotropy, which is induced by orbital ordering, is drastically changed upon photo-irradiation. Photo-irradication melts the orbital ordering within 200 fs. The phenomenon may also be applied to ultrafast optical memory and switching.



Crystal structure of one-dimensional copper oxides (Sr_2CuO_3, Ca_2CuO_3)(a), and one-dimensional halogen bridged nickel compounds ($[Ni(chxn)_2X]Y_2$: X=Cl,Br, Y=Cl,Br,NO_3)(b). Configuration of orbitals constructing one dimensional electron system in copper oxides (c) and halogen bridged nickel compounds (d).

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