

## Latest Results on Flux Pinning Enhancement in MgB<sub>2</sub> and YBCO and Multifunctionality in Novel Two Dimensional CoO<sub>2</sub> Layer Structured Compounds

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We will present our latest results on the studies of MgB<sub>2</sub>, YBCO, NaCoO<sub>2</sub>\*H<sub>2</sub>O superconductors and related systems. The effect of nano-scale dopants such as SiC, Si, C, Al, nano-carbon tubes, and other novel dopants on the enhancement of J<sub>c</sub>(H) and H<sub>c2</sub> in MgB<sub>2</sub> bulks and Fe, Cu/Al sheathed wires/tapes will be reported. C substitution for B, nano-Mg<sub>2</sub>Si inclusion, and grain boundaries are found to be responsible for enhancement in both H<sub>c2</sub> and J<sub>c</sub>(H). MgB<sub>2</sub> with aligned carbon nanotube (CNT) inclusions processed using high magnetic fields exhibited significant improvements in J<sub>c</sub>(H), heat transfer, and mechanical properties. Enhancement of flux pinning has been achieved for YBCO films prepared by PLD or MOD methods through nano-inclusions or appropriate buffer layers on various substrates. Both superconductivity and spintronic functionalities will also be presented for two dimensional CoO layer structured systems. For the Na<sub>x</sub>CoO<sub>2</sub> with or without H<sub>2</sub>O, the effect of Na contents on the structures and properties indicated that the system containing the two dimensional triangular Co lattices can change from paramagnetic insulator/metal, ferromagnetic metal to superconductor, strictly depending on the Na contents. The new K<sub>2</sub>NiF<sub>4</sub> type Sr<sub>2</sub>CoO<sub>4</sub> compounds containing two dimensional Co lattices with and without doping exhibit no superconductivity, but are found to be ferromagnetic metals or half metals showing large changes in resistance in response to magnetic field. Results based on single crystal samples and first-principles band structure calculation will be presented.

Keywords : MgB<sub>2</sub>, YBCO, flux pinning, J<sub>c</sub>, nano-doping, H<sub>c2</sub>, tapes wires, bulks, films, PLD, MOD, CoO layered compounds, half metals.