

# Evolution of magnetic properties of manganites with pressure and doping at Mn-site

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Systematic study of magnetic properties of low tungsten doped  $\text{CaMn}_{1-x}\text{W}_x\text{O}_3$  ( $x \leq 0.1$ ) demonstrates the evolution of weak ferromagnetic-antiferromagnetic ground state with increasing W doping level from the *G*-type AFM state with a weak FM component for ( $x = 0$  and 0.04 cases) to the *C*-type AFM associated with orbital ordering ( $x = 0.1$ ) with no spontaneous magnetic moment. The evidence of exchange bias (EB) effect in  $\text{CaMn}_{0.93}\text{W}_{0.07}\text{O}_3$  appears as shifts along both field and magnetization axes of magnetic hysteresis loops. Systematic studies of magnetic properties of low niobium doped  $\text{CaMn}_{1-x}\text{Nb}_x\text{O}_3$  ( $x \leq 0.1$ ) reveal the evolution of the ground state with increasing Nb doping level from the *G*-type AFM state with a weak FM component for  $x = 0.02$ – $0.08$  to mostly *C*-type AFM associated with charge ordering and tiny spontaneous FM moment ( $x = 0.1$ ). Application of the hydrostatic pressure results in a significant increase of magnetization, related to the growth of FM clusters under pressure and significantly suppresses the EB effect observed for  $\text{CaMn}_{0.9}\text{Nb}_{0.1}\text{O}_3$ .