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Ba_2NiOsO_6: a Dirac-Mott insulator with ferromagnetism near 100 K HL FENG, NIMS, S CALDER, ORNL, M GHIMIRE, Leibniz Inst. SSMR, YH YUAN, NIMS, Y SHIRAKO, Gakushuin Univ, Y TSUJIMOTO, Y MATSUSHITA, NIMS, Z HU, CY KUO, LH TJENG, MPI-CPS, TW PI, YL SOO, NSRRC, JF HE, M TANAKA, Y KATSUYA, NIMS, M RICHTE, Leibniz Inst. SSMR, KAZUNARI YAMAURA, NIMS — The ferromagnetic semiconductor Ba_2NiOsO_6 (T_{mag}~100 K) was synthesized at 6 GPa and 1500 C. It crystallizes into a double perovskite structure [Fm-$3m$; a = 8.0428(1)], where the Ni^{2+} and Os^{6+} ions are perfectly ordered at the perovskite B-site. We show that the spin-orbit coupling of Os^{6+} plays an essential role in opening the charge gap. The magnetic state was investigated by density functional theory calculations and powder neutron diffraction. The latter revealed a collinear ferromagnetic order in a >21-kOe magnetic field at 5 K. The ferromagnetic gapped state is fundamentally different from that of known dilute magnetic semiconductors such as (Ga,Mn)As and (Cd,Mn)Te (T_{mag}<180 K), the spin-gapless semiconductor Mn_2CoAl (T_{mag}~720 K), and the ferromagnetic insulators EuO (T_{mag}~70 K) and $Bi_3Cr_3O_{11}$ (T_{mag}~220 K). It is also qualitatively different from known ferrimagnetic insulator/semiconductors, which are characterized by an antiparallel spin arrangement. Our report of cubic Ba_2NiOsO_6 heralds a new class of FM insulator oxides, which may be useful in developing a practical magnetic semiconductor that can be employed in spintronic and quantum magnetic devices.

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