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Application of Crystal Field Theory in Understanding Magnetic Transitions: Correlating Structural, Chemical, and Magnetic Properties in $Sm_2MnB'O_6$ (B'= Mn, Ce and Ru)

Crystal Field Theory (CFT) provides a fundamental framework for understanding magnetic transitions by elucidating the interactions between transition metal ions and their surrounding ligand fields. In complex oxides such as $Sm_2MnB'O_6$ (B'=Mn, Ce and Ru), CFT plays a crucial role in correlating structural distortions, chemical bonding, and magnetic ordering. This work demonstrates how variations in metal-ligand coordination environments influence spin states, exchange interactions, and overall magnetic behaviour. The interplay of Mn and B'in different polyhedra coordination leads to significant modifications in crystal field splitting, affecting charge distribution and magnetic coupling mechanisms. Additionally, structural distortions, including Jahn-Teller effects and bond angle variations, mediate the observed magnetic transitions from paramagnetic to ordered states. This work underscores the importance of CFT in predicting and tuning magnetic properties in perovskite-like oxides, offering insights into potential applications in spintronics and multifunctional materials.

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None

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