Novel Manganese-Halide 2-D, 1-D and 0-D Frameworks and their Emission Properties

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In the past years metal-halide perovskites (MHPs) attracted much attention as they are exceptional candidates for novel photovoltaic materials. MHPs are not limited to photovoltaics and our goal at NMHU is studying manganese-halide perovskites (MnHPs) for their potential magnetic, ferroelectric, and light emission properties in building LEDs and X- ray detectors. This research was more concerned with low-dimension MnHPs because they tend to be more stable even under higher temperatures than 3-D MnHPs. Manganese-halide compounds normally crystallize with isolated tetrahedral MnX4 units; however, they can also crystallize in 1-D chains, or 2-D layers when organic cations are present. Our group synthesized six new MnHPs using these cations; 4-Aminopyridine (4-AP), 3-Aminopyridine (3-AP), 2,6-Diaminopyridine (2,6-DAP) and Pyridine HBr (PHBr). With 4-AP and PHBr, they crystalized four MnHPs in 1-D chains, with 3-AP we crystalized one MnHPs in 2-D layers and with 2,6-DAP, we crystalized a 0-D MnHPs isolated trimer unit. The figure below is a bulk sample of the synthesized 2,6-DAP trimer displaying peak emission property as is synonymous with these kinds of materials. From our findings, organic cations were involved in hydrogen bonding with chains in their molecules and these bonding substantially supports the stability of the entire organic-inorganic MnHP molecule. In addition to this, H- bonding plays a significant role in the formation and orientation of the different MnHPs; they significantly determine what dimension of is obtained. MnHPs can also be modified by the amount of water present and by the solvent used. They regulate the number of water molecules that will be attached to the Mn center in MnHP as will be seen in our results.

Figure 1: Light emission property of 2,6-Diaminopyridine perovskite under short wavelength UV light