Optical properties of lead-free $Cs_2Na_{0.6}Ag_{0.4}InCl_6:Bi^{3+}$ double perovskite.

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Perovskite materials have emerged as a focal point in materials science owing to their exceptional optical and electronic attributes. Metal-halide double perovskite (MHDPs) are recently booming as promising alternatives for Pb-based halide-perovskite for their non-toxicity and significantly enhanced chemical and thermodynamic stability[1]. Alloyed lead-free double perovskite display intense photoluminescence are environmentally friendly and their devices show long-term operation. Among these perovskites $Cs_2Na_{0.6}Ag_{0.4}InCl_6:Bi^{3+}$ has emerged as a particularly promising candidate. This specific composition offers unique opportunities for exploration, especially in the realm of photovoltaics and LED technology[2]. Luo et al. found that the cation exchange reaction i.e., the partial exchange of Ag^+ with Na^+ cations, results into the break of the parity-forbidden transition. Adding Na^+ alloy and incorporating Bi^{3+} into the perovskite network improves the intense warm white emission of $Cs_2Na_{0.6}Ag_{0.4}InCl_6$ originating from sells-trapped exciting. Investigating the properties and behaviour of $Cs_2Na_{0.6}Ag_{0.4}InCl_6:Bi^{3+}$ is thus essential for advancing our understanding of perovskite materials and unlocking their full potential for practical applications in renewable energy and LED technology[3].

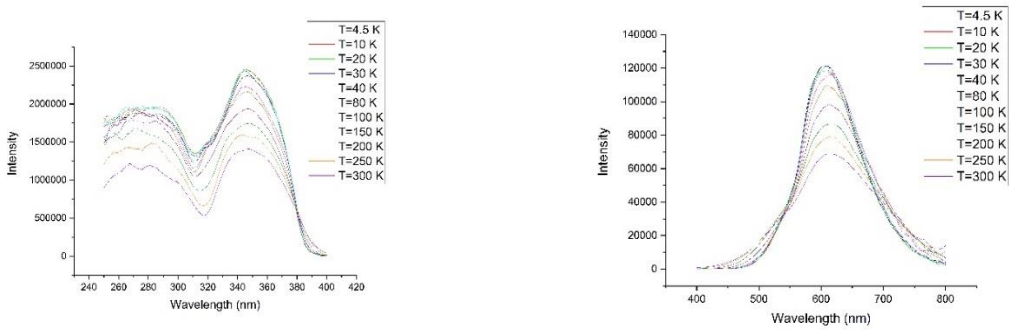

Figure 1. PLE and PL spectra of different temperatures for $Cs_2Na_{0.6}Ag_{0.4}InCl_6:Bi^{3+}$.

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