

Title : The Development of Glass Compositions for Solar Cell Applications.

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ABSTRACT

This research aims to investigate the effect of MnO concentration on technological properties of glass for solar cells application. Original glass was prepared using various cullet including solar cell glass waste which present high Fe_2O_3 content. MnO was added in the original glass in the range of 0.0024 – 0.0192 wt%. The glass mixtures were melted at 1400°C for 5 h, then shaped into sheets and annealed at 550°C for 2 h, followed by a slow cooling process at a rate of 100°C/h. Chemical compositions were analyzed using X-ray Fluorescence Spectroscopy. Light transmittance, color intensity and light reflectance were measured using UV-Vis-NIR Spectrophotometer. The physical properties such as density and hardness were investigated. The results showed that the increase of $\text{SiO}_2/\text{Na}_2\text{O}$ ratio tended to increase the density. MnO dissolved in glass matrix and played a more complex role in the glass structure. The hardness of the glass samples was also increased in the range of 576.26-629.12 HV with increasing MnO content. The redox ratio (R) values of $\text{Mn}^{2+}/\text{Mn}^{3+}$ and $\text{Fe}^{2+}/\text{Fe}^{3+}$ increased, indicating a higher oxidation state in the system. Fe^{2+} ion in the original glass composition has stronger light absorption properties (dark green color) than Fe^{3+} ion (light yellow color). Mn^{3+} ion oxidized Fe^{2+} ion to Fe^{3+} ion resulting to the color reduction of MO-added glasses. The reflectance values (at 200-1000 nm) of all glass formulations remained relatively stable and below 2%. In the 1000-1200 nm range, the reflectance increased around 5-8% with increasing MnO content. The original glass presents the value of light transmittance at 87.85%, while the MnO-added glasses present the increase of light transmittance approximately at 87.04 to 89.07%. It was concluded that the MnO addition trend to improve the technological properties of the high Fe_2O_3 -original glass for solar cells application.

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