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# Thermal-Optical Properties of Polymethylmethacrylate/Silver Nitrate Films

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Polymethylmethacrylate (PMMA)/silver nitrate ($AgNO_3$) films were fabricated and studied in detail. Complex formation was corroborated using x-ray diffraction (XRD) and Fourier-transfer infrared analysis. The XRD analysis showed that the amorphization of PMMA increases after the incorporation of $AgNO_3$. The thermal and optical properties were studied using differential scanning calorimetry (DSC), thermal gravimetric analysis (TGA), and optical absorption, transmission, and reflection. The DSC thermograms revealed that the glass-transition temperature ($T_g$) is a nonmonotonically decreasing function of $AgNO_3$. The TGA scans showed a decrease in the thermal activation energy ($E_a$) values of PMMA with increasing doping levels. The optical absorption spectra showed a broad band in the wavelength region of 288 nm to 481 nm for differently doped films, which were assigned to surface plasmon resonance (SPR) of $AgNO_3$ crystallites. The optical transmission ($T$) and reflection ($R$) data have been analyzed, and hence the refractive index ($n$) was determined and discussed. The dopant concentration dependence of SPR, optical band gap ($E_{opt}$), $n$, and cutoff wavelength ($\lambda_{vis}$) were estimated. It was found that the thermal and optical parameters changed according to the dopant concentration. These changes suggest high sensitivity of these films to doping as candidates for thermal and/or optical sensor applications.

**Key words:** Complex films, DSC, TGA, optical properties

## INTRODUCTION

Optical plastics are important commercial materials and are used widely as substrates for optical storage devices, such as compact discs and digital video discs, optical fibers, and fluorescent solar concentrators.[1] As an optical resin, polymethylmethacrylate (PMMA) has taken the place of optical glass and is extensively used in various fields due to its high transparency, good mechanical properties, surface resistivity, and relatively low cost. Therefore, PMMA finds applications in many fields such as aircraft glazing, signs, lighting, architecture, transportation, and merchandising. Furthermore, since PMMA is odorless, tasteless, and nontoxic, it can be used in dentures, medicine dispensers, food-handling equipment, throat lamps, contact lenses, etc. Particles of noble metals such as silver and gold are of great significance due to their size-dependent optical properties. Silver ion ($Ag^+$) is a fast-conducting ion in a number of crystalline and amorphous materials, and its incorporation within a polymeric system may be expected to increase the electrical and optical performance.[2]

Generally, the wide range of applications of PMMA can be extended even further by blending it with other polymers or by incorporation of inorganic fillers into the PMMA matrix to enhance/tune its properties, which allows improvement of the optical, thermal, mechanical, and electrical properties.[3] For this reason, several researchers have reported on the electrical properties of silver-doped PMMA,[4–7] but very little work on the thermal and optical properties of doped PMMA films is available. In this article, we report the characterization of doped

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