

# **Identification of the temperature-dependent relation between thermo-optical properties and morphology of semi-crystalline thermoplastics for thermoforming process**

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## **ABSTRACT**

Heating stage of the thermoforming of thermoplastics are critical as it has great effect on their formability under forming and therefore product quality. As radiation heat transfer is widely used for the heating of thermoplastic preforms, physical background of the radiation heating of bulk thermoplastic polymers has to be understood well for an accurate prediction on their temperature profile. In the past, many numerical approaches were developed based on thermo-optical characteristics of thermoplastics whereas little attention was given to the relation between their microstructure and thermo-optical parameters. Considering semi-crystalline thermoplastics the effect of microcrystalline structure is key to identify the thermo-optical properties and develop an accurate numerical radiative heat transfer model for optimization of thermoforming process. Previous studies in literature showed that there is a strong coupling between microstructure of semi-crystalline thermoplastics and their thermo-optical properties in the near-infrared spectral region. In the present work, the relation between thermo-optical characteristics and microstructure of polyolefin-based (PO) polymer was studied considering the change in its morphology at various temperatures. The optical characteristics of the PO were experimentally analyzed under heating conditions using an in-house developed device that is built using a Fourier Transform Infrared spectroscopy, integrating sphere and heating plate. Thanks to the analyses, the changes in the thermo-optical properties of the PO were correlated to its varying morphology under increasing temperature. As semi-crystalline thermoplastics are heated up to melting temperature to soften enough for successful forming process, their microcrystalline structure may show variation above glass transition temperature and this temperature-dependent relation cannot be neglected for building an accurate numerical model for infrared heating assisted thermoforming.