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Raman Spectroscopy as a Method for Investigating Inclusions in Glass

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Biography

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Abstract

The diagnosis of glass defects is a crucial component of technological quality control in production. The prompt identification of the type and composition of defects enables the determination of their causes and the prevention of significant production losses associated with the quality of glass products. Investigating the processes of glass formation while optimizing industrial glass compositions also necessitates the identification of the type and composition of inclusions, particularly crystalline ones. Crystalline inclusions, being the most significant defects in glass, warrant particular scrutiny as they may indicate serious violations within the technological process. The presence of batch inclusions (batch stones) could stem from inconsistencies in the preparation technology, as well as alterations in the phase and granulometric composition of the raw materials. Inclusions of refractories point to their active corrosion and may serve as a harbinger of issues with the lining of the glass furnace. The presence of crystallization stones typically signifies a disruption in the temperature regime within the melting zone. Additionally, other inclusions may also be present within the glass. The work presents the development of a methodology for investigating crystalline inclusions in glass using Raman spectroscopy. The application of Raman spectroscopy in the study of glass melting processes enables the determination of the composition of the products resulting from the interaction of batch components, as well as the temperature-time conditions required to achieve homogeneity in the melt. For instance, it has been established that the glass formation processes during the melting of glasses in the $MgO–CaO–Fe_2O_3–Al_2O_3–SiO_2$ system culminate in the dissolution of quartz and the formation of anorthite during the silicate formation stage within the temperature range of 1250–1350 °C.