Interaction of electron beam with ionic liquids and its application for micropatterning.

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The high-energy electrons can induce significant physicochemical changes in ionic liquids (ILs), of which polymerization and solidification are particularly interesting due to potential application in microstructures fabrication using electron beam (EB) patterning. However, the role of allyl and alkyl substituents of cation in these phenomena is not clear. Thus, we investigate the effect of electron dose on microscale polymerization of ammonium- and imidazolium-based ILs with different numbers of polymerizable groups. We show that the minimum electron dose for solidification decreases as the number of allyl substituents in cation is increased. Interestingly, ILs without polymerizable substituents are also solidified by EB irradiation. Consequently, we suggest that IL monomers undergo two mechanisms during EB exposure: free radical chain-growth polymerization via allyl groups and cross-linking between monomer/oligomer/polymer radicals. We also study the applicability of IL thin films for EB lithography in terms of sensitivity and contrast of resist material. Moreover, we demonstrate that suspended polymer structures, potentially attractive as photonic components, can be fabricated out of ILs using controlled-acceleration-voltage electron beam lithography (CAV-EBL). This method enables us to examine the effect of electron energy on the solidification depth in IL layer and, as a consequence, estimate the electron range for this material.

Słowa kluczowe

Polymerizable ionic liquids, Allyl group, Crosslinking, Patterning, Electron beam lithography, Accelerating voltage

Adres publiczny

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