

Development of the novel process for direct polymerization using elemental sulfur to synthesize the ultra-high refractive index ($n > 1.9$) polymer

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High refractive index polymers (HRIPs), which have refractive index exceeding 1.6, are made easily to various complex forms, and they exhibit lower cost, and lighter weight compared to inorganic materials, many researchers have tried to substitute the inorganic materials to HRIPs for wide range of photonic devices. However, up to date, the developed HRIPs have still shown lower refractive index about 1.7~1.8, and which is too low to perform efficiently as optical materials. Herein, our groups developed a novel synthesis process for direct polymerization using elemental sulfur, termed sulfur chemical vapor deposition, to synthesize successfully ultra-high refractive index ($n > 1.9$) polymers. The sCVD process was primarily based on vapor-phase radical polymerization between elemental sulfur and vinyl monomers, so the formation of long polysulfide chains which cause red shift in UV-visible adsorption was suppressed efficiently. As a result, the HRIP thin film showed not only unprecedented high refractive index about 1.91, but also optical transparency throughout the visible range. The developed HRIPs will serve as a key component in a wide range of optoelectronic device.