

The Sub-Micron Hole Array in Sapphire Produced by Inductively-Coupled
Plasma Reactive Ion Etching

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Abstract

The sub-micron hole array in a sapphire substrate was fabricated by using nanosphere lithography (NSL) combined with inductively-coupled-plasma reactive ion etching (ICP-RIE) technique. Polystyrene nanospheres of about 600 nm diameter were self-assembled on c-plane sapphire substrates by the spin-coating method. The diameter of polystyrene nanosphere was modified by using oxygen plasma in ICP-RIE system. The size of nanosphere modified by oxygen plasma was varied from 550 to 450 nm with different etching times from 15 to 35 s. The chromium thin film of 100 nm thick was then deposited on the shrunk nanospheres on the substrate by electron-beam evaporation system. The honeycomb type chromium mask can be obtained on the sapphire substrate after the polystyrene nanospheres were removed. The substrate was further etched in two sets of chlorine/Argon and boron trichloride/Argon mixture gases at constant pressure of 50 mTorr in ICP-RIE processes. The 400 nm hole array in diameter can be successfully produced under suitable boron trichloride/Argon gas flow ratio.

Keyword : Al₂O₃, Sub-Micron Hole Array, ICP-RIE, Polystyrene Nanosphere