Synthesis and Properties of Fluoro-poly (ether ether ketone) and Fluoro-poly (aryl ether ketone)s with Low Dielectric Constant*

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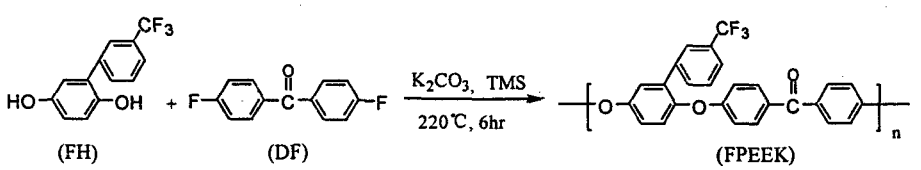
As device dimensions continue to shrink and wiring patterns for chip interconnects, transmission lines, chip-module and module-board connects, etc., become denser, access and cycle times are strongly effected by transmission delays and capacitive and inductive coupling between conductors, adversely effecting performance.[1,2] Significant reduction in the insulator dielectric constant can dramatically decrease transmission delays and reduce electronic crosstalk and capacitive coupling between conductor lines allowing the fabrication of denser multilevel wiring patterns. One potential approach toward pushing dielectric constants lower is closed-cell organic and/or inorganic polymeric foams, [3,4] materials with significant void volumes. Such materials would also have to be stable to high temperatures, impermeable to corrosive reagents, possess high glass transition temperature and contain voids which are small relative to the electronic features.

Research has shown that the incorporation of fluoro-pendant groups into polymers enhances solubility, thermal stability, flame resistance, resistance to water, electrical insulating properties, while decreasing dielectric constants, crystallinity and color. [5,6]

Owing to above ideas, a novel fluoro-monomer of 2–(3'-trifuoromethyl) phenyl-hydroquinone (FH) was synthesized based on industrial raw material, and a fluoro-poly (ether ether ketone) (FPEEK) and a fluoro-poly (ether ehter sulfone) (FPEES) were synthesized by nucleophilic substitution reactions based on this monomer, 4,4'-difluorobenzophnone and 4,4'-dichlorodiphenyl sulfone. The synthesis routes of the polymers were illustrated in the schematic (scheme 1 and scheme 2). The properties of FPEEK and FPEES were characterized by a variety of methods, and the results showed that dielectric constant of FPEEK and FPEES were 2.7 and 2.74 respectively.



(FH) (DF) (FPEEK)

Scheme 1 The synthesis route of FPEEK

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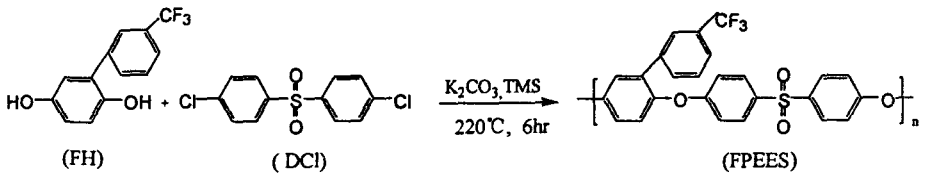

Scheme 2 The synthesis route of FPEES

FPEEK and FPEES can be dissolved in a wide range of organic solvents such as DMF, DMAc, DMSO, NMP, TMS, dichloromethane, chloroform etc. Thin films of the polymers cast from chloroform are transparent, creasable and tough. FPEEK and FPEES had excellent mechanical and thermal properties. Coating film had a strong adhesion force and resistance to impact with surface substrates. Study on electric properties of polymers indicated that they had very good electric properties. These polymers will play an important role in electronic and communication industry.

References

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