MECHANICAL AND OPTICAL PROPERTIES OF PLASMA POLYMER FILMS DEPOSITED FROM A MIXTURE OF TETRAVINYLSILANE AND OXYGEN GAS USING PULSED PLASMA

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Plasma-polymerized organosilicones constitute a class of materials with a rich and varied scientific background. This class of materials possesses a special characteristic, which distinguishes it from other plasma polymers – the ability to vary and control the degree of its organic/inorganic character (i.e., the carbon content) by the appropriate choice of fabrication variables. This allows one to control many physicochemical properties over wide ranges resulting in an extraordinary potential for useful applications, which are only now beginning to be tapped. The organosilicon plasma polymers are widely recognized for their potential not only in optical and electronic applications, but also in composites and nanocomposites with controlled interphase.

Plasma-enhanced chemical vapor deposition (PECVD) was used to prepare thin films of tetravinylsilane in a mixture with oxygen gas employing an RF (13.56 MHz) helical coupling pulsed-plasma system. Plasma polymer films of the thickness about 1 μm were deposited on silicon substrates at different powers (0.1 – 10 W) and oxygen content (0 – 79%) in mixture. We found out that oxygen atoms incorporated into plasma polymer network modified not only the elemental composition but also the chemical structure of the material [1]. We will demonstrate an influence of oxygen on mechanical and optical properties of modified material in correlation with the chemical structure. The oxygen incorporated in Si–O–C bonding species resulted in a decrease of the refractive index and shift of the UV absorption edge towards shorter wavelength. A higher amount of oxygen (≥60%) in the mixture resulted in a reduction of the Young's modulus and hardness due to the decreased cross-linking of plasma polymer. The physico-chemical properties of deposited films can be controlled by the effective power and amount of oxygen in the mixture.

1. V. Cech, J. Studynka, F. Janos, and V. Perina, Plasma Proc. Polym. 4 (2007) S776-80.

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