MODIFIED SILICONE ELASTOMERS FOR BIOMEDICAL PROSTHETIC APPLICATIONS

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Introduction

Silicone rubber (SR) has been used in medical science for a variety of advanced prosthetic applications, including maxillofacial reconstruction, cohlear implants, artificial corneas and artificial skin. From a clinical viewpoint, it is important that the bioimplant material retains a combination of good mechanical properties, chemical stability and biocompatibility [Abbasi, 2001]. Appropriate inorganic nanoparticles reinforcement will help SR prosthesis to meet the above mentioned requirements. It is mentioned that nanostructured materials promote biological response and this is related to the fact that living systems are governed by the molecular behavior occurring at the nanometer scale. In this work different types of inorganic nanoparticles were examined for SR reinforcement and the thermal, mechanical and bioactivity characteristics of the prepared nanocomposites were investigated.

Methods

Condensation cured polydimethylsiloxane (PDMS) nanocomposites reinforced with organically modified montmorillonite (OMMT: Cloisite 20A, Cloisite 30B), hydroxyapatite (HA) and silica (Aerosil R972) nanoparticles, were prepared using the sonication technique and subsequently characterized by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA), whereas their tensile and tear properties were also tested. An *"in-vitro"* assay of bioactivity was carried out by soaking PDMS hybrids in Simulated Body Fluid (SBF) at pH 7.4. Also, cell cultures of primary fibroblasts have been performed on SR hybrids (MTT test).

Results- Discussion

The incorporation of organoclays, silica and HA nanoparticles into PDMS does not have any obvious effect on the T_g of the elastomer. From Fig. 1 it is observed that Cloisite 20A is the most effective filler for the improvement of nanocomposite's thermal resistance, followed by Cloisite 30B and HA, whereas silica nanoparticles reduce the thermal resistance of the elastomer.

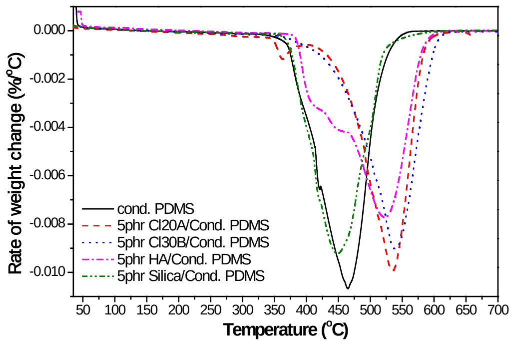

Figure 1: TGA curves of PDMS nanocomposites.

The mechanical properties of pure PDMS seem to be significantly improved by the incorporation of organoclays and silica reinforcement (Table 1). HA does not have any positive effect on the examined properties of PDMS.

Material type	**Tensile strength** MPa	**Mod. of elastic .** (MPa)	**Tear strength** (Nt/mm)
PDMS	0.32	1.27	0.114
Cl20A/PDMS	0.92	1.79	0.261
Cl30B/PDMS	0.53	1.51	0.274
Silica/PDMS	0.63	1.48	-
HA/PDMS	0.34	1.30	0.103

Table 1: Mechanical properties of PDMS and 5 phr loaded PDMA nanocomposites.

The evaluation of bioactivity by immersion of samples in SBF solution revealed formation of Ca/P compounds on the surface of silica and HA/PDMS nanocomposites, after 21 days of immersion. OMMT and especially Cloisite 20A, are the most efficient reinforcement for improving the thermal stability and mechanical properties of SR nanocomposites. On the other hand, HA and silica hybrids present some better bioactivity properties.

References

Abbasi *et al*, Polym Int, 50:1279-1287, 2001.