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Research paper

Mechanical characteristics of an Ormocomp® biocompatible hybrid photopolymer

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ABSTRACT

In this work, the mechanical behaviour of a photocured Ormocomp® hybrid material is investigated. Its biocompatible nature has attracted a growing interest for microfabrication applications in biomedicine and tissue engineering. Measurements of in situ solidification strain development and achieved degree of curing, as obtained using a fibre optic sensor, are presented. The results show that the solidification strains generated during UV-curing are significant at the maximum achieved degree of curing. The mechanical response (Young's modulus) of the material was investigated by testing of thin-film and regular size specimens. It was found that the measured mean elastic modulus of the thin-film specimens was of the same order of magnitude as that of the larger specimens but noticeably smaller.

1. Introduction

In recent years a growing interest is observed for the use of inorganic–organic hybrid materials in biomedical applications. These hybrid materials are prepared by solution and gelation processes (sol–gel process) starting from liquid precursors (Hass and Wolter, 1999) while their material properties can be influenced in a wide range by means of chemical design (Ovsianikov et al., 2007). ORMOCER®s (a trademark of the Fraunhofer-Institute in Germany) is one such material. These hybrid sol–gel materials exhibit strong covalent bonds between inorganic and organic moieties (Hass and Wolter, 1999). Cross-linking between inorganic and organic groups provides Ormocer®s with exceptional chemical and thermal stability (Sanchez et al., 2005). In dental applications Ormocer®s are used as dental restoratives in an attempt to overcome the problems created by the polymerisation shrinkage of conventional composites because the coefficient of thermal expansion of Ormocer®s is very similar to the natural tooth structure (Sivakumar and Valiathan, 2006). Ormocer®-based light-curable dental composites have been commercially available for use in restorative dentistry since 1988 (Doraiswamy et al., 2006). Besides dentistry, these materials have been successfully used in various other applications such as electronics, micro-mechanical systems and corrosion coatings (Houbertz et al., 2003; Popall et al., 2000).

One of the most promising application of such materials is in the photo-fabrication (UV-curing) by rapid prototyping

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