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# Setting process of glass ionomer cements studied by dielectric spectroscopy

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## Abstract

Glass ionomer cements (GICs) belong to the class of restorative dental materials with a long and extensive usage. These materials consist of an aluminofluorosilicate glass powder and an aqueous polyacrylic acid and the cement formation arises from the acid–base reaction between components. Over the past decade, a significant effort has been undertaken to develop a hybrid material composed of the glass ionomer and an additional component, resins for example, to obtain the material with superior mechanical and esthetical properties. In such resin-modified glass ionomer (RM-GI), the setting process involves an acid–base reaction and polymerization (light and/or chemically activated). The key point in designing an advanced dental material with desired properties is a thorough understanding of the setting reaction. In this study, the setting process in the commercial GIC (Fuji IX Fast) and RM-GI (Fuji II LC) was investigated by dielectric spectroscopy and digital laser interferometry. The changes in the real and imaginary parts of the dielectric permittivity as well as dielectric loss tangent with time for Fuji IX Fast show several distinct regions which can be related to the different stages of the acid–base reaction. Interestingly, the first stage that lasts for approximately 12 minutes terminates with a sharp decrease in dielectric parameters which is most probably related to the instantaneous (micro)fracturing of the sample due to a rapid build-up of the shrinkage stress. On the contrary, evolution of the dielectric properties during the setting of Fuji II LC indicates fast light-activated polymerization in the initial stage (less than a minute) followed by the slow gradual change. This results from the competing nature of the acid–base reaction and light-activated polymerization. In general, these results demonstrate that the dielectric spectroscopy is a sensitive tool for monitoring the complex changes during the setting process in dental materials.

**Keywords:** dental materials, glass ionomer cements, setting reaction, dielectric spectroscopy

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