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Abstract

Nanocharacterization of Dental Materials by Atomic Force Microscopy and Their Thermal Degradation Evaluation †

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Abstract: Restorative dental materials must be produced with special characteristics because they are operating in a medium environment with different humidity and temperature. These day-to-day factors play an important role in the lifetime of such dental restorative materials. Resin composites have been by far the most successful in dental applications by meeting several stringent design requirements that are difficult to achieve with homogeneous materials, such as ceramics and metal alloys. The mechanical and tribological properties of direct restorative filling materials are crucial not only to serve and allow similarity to human enamel and dentine, but also to compare composites between them and determine the objective criteria for their selection. The objective of this research is to investigate the mechanical and tribological properties of some commercial restorative materials using the atomic force microscopy technique as a function of the operating temperature. Therefore, restorative materials are expected to replace and perform as natural tooth materials. The demand is so great that most of the time, restorative filling materials replace enamel and dentin, which have very different mechanical properties, namely hardness and elastic modulus. The scope is to estimate the lifetime of such materials starting from their nano-behaviors under nano-wear, nano-friction, nano-mechanical tests. To conclude, nanoindentation is an attractive method for measuring the mechanical behavior of small specimen volumes in dental hard materials. Using this technique, the mechanical and tribological properties of nanocomposite resins were investigated. This technique only evaluates the tribo-mechanical properties of a very shallow surface region of a specimen that may have undergone damage associated with mechanical preparation that is required to achieve a satisfactory flat sample for testing. Experimental study has been carried out with several normal loads and time-duration tests, i.e., representing several steps of severity conditions for materials under investigation.

Keywords: dental materials; temperature effect; hardness; modulus of elasticity friction; wear; adhesion effect

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