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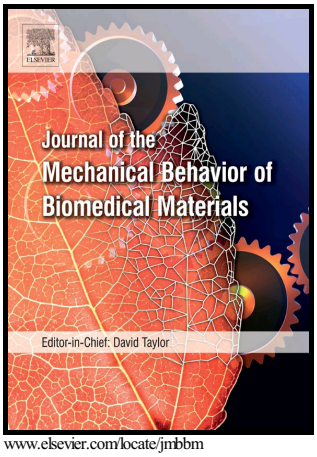

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Impact of strain rate on the hardness and elastic modulus of human tooth enamel

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Abstract

Human tooth enamel is a natural biocomposite consisting of mineral units surrounded by a soft protein shell. The mechanical behaviors of enamel are closely associated with its structure. In this paper, the strain-rate dependent mechanical properties of enamel were investigated with nanoindentation techniques. Five constant strain rates (0.01 s^{-1}, 0.03 s^{-1}, 0.05 s^{-1}, 0.1 s^{-1}, 0.3 s^{-1}) were used in this study. Results showed that the hardness and elastic modulus of enamel increased with increasing strain rate. These results indicate that the variation of hardness under different stain rates is associated with creep behavior of organic matrix in enamel. And indentation creep rate sensitivity of human enamel was measured with a value of 0.062. Moreover, the elastic module of enamel is dependent upon strain rate. Such rate dependence originates from the organic matrix which is sensitive to the strain rate. This behavior may be important in explaining the excellent toughness and energy absorption abilities of natural tooth structure.

Keywords: Human tooth enamel; Strain rate; Hardness; Elastic modulus

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