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Mesoscopic modeling of the response of human dental enamel to mid-infrared radiation ANA VILA VERDE, Department of Chemical Engineering, Penn State University, MARTA RAMOS, Department of Physics, University of Minho, Portugal, A.M. STONEHAM, Centre for Materials Research, Department of Physics and Astronomy, University College London, UK — Ablation of human dental enamel, a composite biomaterial with water pores, is of significant importance in minimally invasive laser dentistry but progress in the area is hampered by the lack of optimal laser parameters. We use mesoscopic finite element models of this material to study its response to mid-infrared radiation. Our results indicate that the cost-effective, off-the-shelf CO_2 laser at $\lambda = 10.6$ μm may in fact ablate enamel precisely, reproducibly and with limited unwanted side effects such as cracking or heating, provided that a pulse duration of ≈ 10 μs is used. Furthermore, our results also indicate that the Er:YAG laser ($\lambda = 2.94$ μm), currently popular for laser dentistry, may in fact cause unwanted deep cracking in the enamel when regions with unusually high water content are irradiated, and also provide an explanation for the large range of ablation threshold values observed for this material. The model may be easily adapted to study the response of any composite material to infrared radiation and thus may be useful for the scientific community.

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