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# Characterization of sodium & calcium addition on immediate aqueous interactions of binary borate glasses by DVS with in-situ Raman

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**Abstract:**

Mineralization of bioactive borate glasses (BGs) in physiological solutions is initiated by ionic exchange and their network dissolution with water. Therefore, understanding the immediate aqueous interactions of BGs could be critical for their tailoring to a desired bioactivity and specific biomedical application. This study describes a novel technique based on dynamic vapour sorption (DVS) with in-situ Raman spectroscopy to investigate the reactivity and mechanisms of aqueous interactions of BGs.

Two melt-quench-derived binary-BGs; (70)B2O3-(30)Na2O and (70)B2O3-(30)CaO (mol%), were investigated to compare the effect of sodium and calcium addition on boron coordination, glass transition temperature, and aqueous interactions, via DVS as well as dissolution in deionized water. DVS, which gravimetrically measures the effect of exposing BGs to a controlled relative humidity, was applied to evaluate their glass-water reactivity.

Meanwhile, in-situ Raman spectroscopy monitored the real-time structural changes of these two BGs to enlighten their different aqueous reactions and characterize the vapour- and water-induced crystallization of sodium borate glasses, which were confirmed through Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy and X-ray Diffraction.

In conclusion, correlation of structural changes and reaction rates between vapour- and water-induced reactions validated the coupling of DVS and in-situ Raman as a more sensitive approach to characterize aqueous reactivity and reactions of BGs compared to traditional methods, such as submersion in aqueous solutions.

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