Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.4290

Photo-Induced Force Microscopy (PiFM): A New Technique at the (Bio)Mineralogist's Fingertips

LAURA M. OTTER[1], MICHAEL W. FÖRSTER[2], ELENA BELOUSOVA[2], PADRAIC O'REILLY[3], DEREK NOWAK[3], SUNG PARK[3], SIMON CLARK[2], STEPHEN F. FOLEY[2] AND DORRIT JACOB[1]

[1]Australian National University

[2]Macquarie University

[3]Molecular Vista

Presenting Author: Laura.Otter@anu.edu.au

Photo-Induced Force Microscopy (PiFM): A New Technique at the (Bio)Mineralogist's Fingertips

L. M. Otter[1*], M. W. Förster[2], E. Belousova[2], P. O'Reilly[3], D. Nowak[3], S. Clark[2], S. F. Foley[2], D. E. Jacob[1]

[1] Research School of Earth Sciences, Australian National University, Canberra, ACT 0200, Australia

[2] Department of Earth and Environmental Sciences, Macquarie University, Sydney, NSW 2109, Australia

[3] Molecular Vista Inc., 6840 Via Del Oro, Suite 110, San Jose, CA 95119, USA

[*] Correspondence to LMO via laura.otter@anu.edu.au

Photo-Induced Force Microscopy (PiFM) is a promising new nanoanalytical imaging technique that offers simultaneous acquisition of 3D topographic data with molecular compound identification at the nanoscale. Contrasting to many other molecular compound identification techniques that cannot operate beyond the diffraction limit of light, PiFM takes advantage of the attractive forces between the sample surface and a sharp tip mounted to a highly sensitive AFM cantilever, while a tunable laser sweeps across a wide range of wavenumbers in the IR spectrum. Hence, the molecular absorption characteristics of PiFM are comparable to those in FTIR absorption spectra allowing the PiFM operator to take advantage of the extensive, pre-existing FTIR databases for phase identification[1].

Since its development in 2010, PiFM has contributed to new discoveries across a broad range of disciplines within the natural sciences and has seen its first applications to different biogeochemical problems [2]. Here we present aspplications of PiFM to different geological and biomineralic systems including the visualization of nano-scale growth zoning in zircons, the speciation of light volatile elements in minerals and glass, and the identification of functional groups present in the organic phases of biominerals. Its high spatial (~5 nm) and spectral (~1 cm^{-1}) resolution and fast mapping rates make this non-destructive technique ideally suited for the in-situ investigation of sensitive, hydrous, hierarchically complex bio-composite materials such as nacre that are especially challenging to analyse at atomic to nano length scales[3].

References

[1] Nowak, Morrison et al., (2016). *Science advances*, 2(3), e1501571. [2] Otter, Förster et al., (2021). *Geostandards and geoanalytical research*. Accepted manucript. [3] Eder, Otter et al., (2019). *Geostandards and Geoanalytical Research*, 43(3), 385-395.