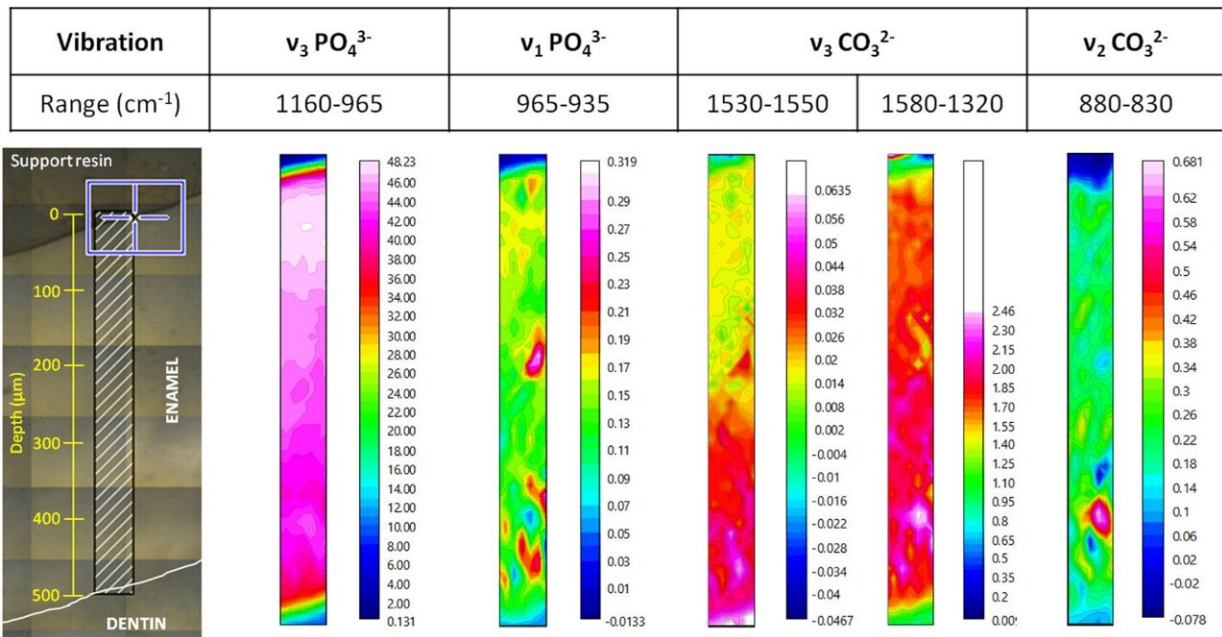


Synchrotron light for faster and more effective tooth whitening treatments

March 31 2022



Chemical distribution of carbonates and phosphates in the middle crown of a bovine incisor control tooth (vertical section). Credit: Autonomous University of Barcelona

Researchers of the Universitat Autònoma de Barcelona (UAB) in collaboration with the ALBA Synchrotron have studied the side effects of typical tooth whitening treatments based on oxidation compared to a new treatment developed by the authors through reduction. Results, published in *Dental Materials*, showed the whitening effect of the novel

treatment to be highly improved in terms of application time needed, efficiency and safety, which makes it a promising candidate to develop novel whitening treatments. Experiments at the MIRAS beamline of ALBA helped to determine the chemical mineral modifications in the dental enamel.

To obtain better tooth whitening results, higher concentrations of oxidizing agents and longer application times are needed, but this may increase side effects like hypersensitivity and pulp damage, tooth demineralization and gingival irritation. Additionally, the need to apply these products for hours is not very comfortable for the user.

Typical tooth whitening treatments are based on the oxidizing power of hydrogen peroxide, which breaks the double bonds of the staining molecules on the teeth's surface making them unable to absorb light. This way, the molecule becomes transparent, resulting in a bright, white smile.

The researchers used bovine incisors as in vitro model to study the side effects of whitening treatments. They compared typical whitening treatments (based on oxidation with carbamide peroxide) to a new treatment developed and patented by the authors through reduction via metabisulfite, which also makes the staining molecules colorless. However, metabisulfite presents a faster whitening effect, which permits the use of lower concentrations and shorter application times. Results showed how the whitening effect of the novel treatment is highly improved in terms of application time needed, with the consequent reduction of side effects. This makes it a promising candidate to develop novel whitening treatments.

"The whitening effect increased when metabisulfite is encapsulated within liposomes (vesicles made out of lipids), since it favors the diffusion of the reducing agent into the enamel, obtaining significant

whitening results in 3 minutes," explains Manuel Valiente, professor of the UAB's Department of Chemistry and director of GTS.

In addition, they found that using oxidizing or reducing treatments promotes different mineral changes. This was known thanks to the chemical imaging performed at the MIRAS [beamline](#) of ALBA. It is the first time that synchrotron light is used to map the bovine incisor's enamel chemically, and to determine the effect of a whitening treatment in terms of chemical mineral modifications, and the extent in deep of these effects.

Experiments at the MIRAS beamline in ALBA

When analyzing the side effects of whitening treatments on enamel, most of the studies are focused on determining the changes in its [mechanical properties](#), like surface hardness or roughness; however, these techniques are not able to provide information about the chemical changes taking place.

Fourier transformed infrared (FTIR) spectroscopy is a molecular vibrational technique that has been shown to be advantageous to investigate mineralized tissues like teeth, providing information on the chemical structure at the molecular scale. The addition of a microscope to FTIR [microspectroscopy](#) has led to the possibility of combining biochemical with spatial information. This is known as chemical imaging and has the potential to examine tissues at cellular resolution.

"Synchrotron-based Fourier transformed infrared microspectroscopy technique, available at the MIRAS beamline in the ALBA Synchrotron, can provide very precise chemical information in small areas, therefore it is a very suitable technique to study the changes induced by whitening treatments and to characterize the extent of its effects with precision," explains Ibraheem Yousef, scientist responsible of MIRAS beamline.

More information: Clara Babot-Marquillas et al, Tooth whitening effects on dental enamel, oxidation or reduction? Comparison of physicochemical alterations in bovine enamel using Synchrotron-based Micro-FTIR, *Dental Materials* (2022). [DOI: 10.1016/j.dental.2022.02.006](https://doi.org/10.1016/j.dental.2022.02.006)

Provided by Autonomous University of Barcelona

Citation: Synchrotron light for faster and more effective tooth whitening treatments (2022, March 31) retrieved 24 April 2024 from <https://medicalxpress.com/news/2022-03-synchrotron-faster-effective-tooth-whitening.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.