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Tuning vibrations for label-free biological imaging

To map molecules in cells and tissue, researchers prefer biomedical imaging techniques that rely solely on the intrinsic responses of chemical bonds to optical stimulation. Although fluorescence microscopy and other chemical tagging methods yield high-resolution images, they also introduce foreign species or synthetic derivatives that can alter the dynamics of intracellular processes. Spontaneous Raman scattering, which uses a single laser beam to excite the vibrational and rotational modes in chemical bonds, requires no chemical labels but generates a weak signal that gets muddled by Rayleigh scattering. A more sensitive technique known as coherent anti-Stokes Raman scattering uses multiple laser beams to generate coherent optical signals that enhance resonant frequencies in the sample; that method, however, also produces nonresonant background noise. Recently a team led by Harvard University chemist [Sunney Xie](#) demonstrated a new technique based on stimulated Raman scattering that tunes the difference between the frequencies of two laser beams to match a desired molecule's resonant frequency, thus amplifying the Raman signal. The measurable intensities of the transmitted beams change only when a match occurs; nonresonant signals are not picked up. The images show the top view (a) and the depth profile (b) of an acne medication (blue) that penetrated a mouse's skin, thus demonstrating the potential of the new technique to monitor drug delivery. ([C. W. Freudiger et al., *Science* 322, 1857, 2008.](#))

— Jermev N. A. Matthews

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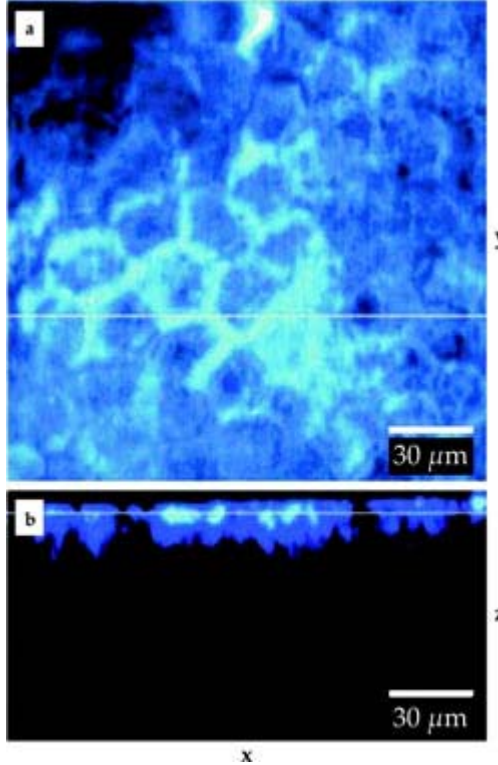
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