

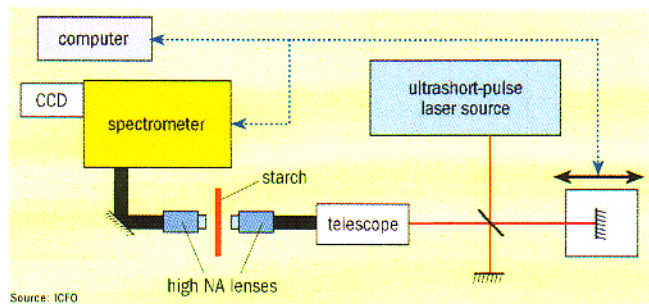
ULTRAFAST PHOTONICS

# Starch offers ultrashort pulse check

Starch is an ideal nonlinear medium for characterizing ultrashort pulses, say researchers in Spain. By placing a starch suspension in the sample plane of a nonlinear microscope, the team says it can characterize ultrashort pulses.

In the past, researchers have been forced to use thin, expensive nonlinear crystals to characterize pulses. However, the Spanish team says that sandwiching a starch suspension between two microscope coverslips works just as well.

"We can determine the temporal and spectral shape of the pulse, as well as the exact phase at the focal plane of the microscope's high numerical aperture [NA] lens," Iain Cormack, a researcher based at the Institut de Ciències Fotòniques (ICFO) in Barcelona told *OLE*. "Traditional techniques can only infer the pulse duration and provide



Source: ICFO

**Simple solution: the Spanish researchers say that a starch solution works just as well as a nonlinear crystal when it comes to characterizing ultrashort pulses.**

little phase information."

Armed with these extra data, the ICFO group hopes to optimize pulses for nonlinear microscopy. "We plan to tailor the exact pulse profile to investigate which phase profile produces a maximum fluorescence signal," explained Cormack. "This is important in life science where imaging living cells

requires the minimum amount of light to avoid photodamage."

The Spanish technique involves passing ultrashort pulses through a Michelson interferometer. A telescope expands the recombined output from the interferometer to fill the aperture of the high NA objective lens. The pulses exit the objective lens and pass through the

starch suspension. This generates a second harmonic signal in the starch, which is passed to a spectrometer for analysis.

Any nonlinear material used in such a set-up must meet several criteria. For example, it must be able to cope with the range of incident angles at the sample plane; be polarization insensitive; and have a large spectral bandwidth. According to Cormack, starch meets all of these criteria. There are also some practical advantages: starch is non-toxic and inexpensive, as well as easy to store, obtain and handle.

The research team has successfully characterized ultrashort pulses from two sources: a mode-locked Ti:sapphire emitting at 830 nm and an optical parametric oscillator operating at 1100 nm. The NA of the lenses used was 1.25 and 0.85 respectively.