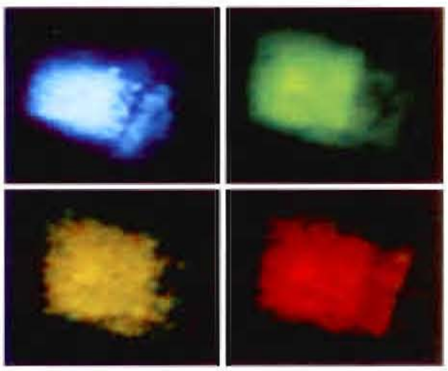
of the need to measure amplitude and phase. Sébastien Popoff and colleagues at the École Supérieure de Physique et de Chimie Industrielles (ESPCI) in France have now experimentally measured the transmission matrix of a random multiple-scattering medium at visible wavelengths. To access the complex optical field, the team used a spatial light modulator and interference with a well-known reference wavefront. A 532 nm laser source was first expanded, then spatially modulated before illuminating a ZnO sample with a thickness of about 80 μm on a microscope slide, and the output speckle was imaged using a CCD. With the matrix known, a host of applications are possible. For example, one can focus to a spot through the complex media, as the group experimentally demonstrated, or inversely detect amplitude and phase at an object placed near the scattering sample.

NANOCRYSTALS

Broad and stable emission

Nano Lett. **10,** 1466–1471 (2010)



Luminescence from solid films is potentially useful for display technology and other applications. Unfortunately, tunable blue light emission in cubic silicon carbide nanocrystal films has been hampered by complicated surface chemical disorder and the presence of amorphous material. Now, Paul Chu and colleagues from China have successfully demonstrated tunable, broad and stable violet to blue-green emission in such nanocrystal films bonded using glycerol. It is believed that the glycerol-bonding prevents the formation of non-radiative defects and surface states. The result is a quasi-continuous band in the conduction band, in contrast with the isolated levels found in bare nanocrystals, providing continuously tunable light emission. The possibility of photoluminescence from the glycerol itself was ruled out by measuring the emission from pure glycerol excited at the wavelength of interest. As an application, the team coated the glycerol-passivated cubic silicon carbide onto porous silicon and obtained strong photoluminescence tunable within the entire visible range (360–760 nm) by changing the incident wavelength.

HIGH HARMONIC GENERATION

Tunable enhancement

Phys Rev Lett. **104,** 073901 (2010)

Although the generation of coherent light in extreme-ultraviolet and X-ray regions by high harmonic generation (HHG) has been extensively studied, its applications have been hindered by the low efficiency of the HHG process, which is due to the difficulty of phase matching. Carles Serrat and Jens Biegert from Spain have now reported a method that can generate short-wavelength coherent light without such a limitation. The approach is based on exploiting a static periodic electric field (created by interferometry with a CO_2 laser) in a neon gas. The period of the static electric field is parallel to the propagation direction of a fundamental driving laser beam. In the calculation, the team considered an 800 nm linearly polarized laser pulse with pulse width of 5 fs, diameter of 40 μm and peak intensity at focus of 7×10^{14} W cm^{-2}. The simulated spectral power showed that 93–99th harmonic waves near 140–160 eV were enhanced with respect to those without the static electric field. The enhanced region of HHG could be controlled by means of the period of the static electric field. The enhancement was also sensitive to the carrier–envelope phase of the generated harmonics. An enhanced coherent radiation of more than two orders of magnitude in the X-ray region was reported in the presence of a static electric field as weak as 1.12 MV cm^{-1}.

PHOTOACOUSTIC IMAGING

Tone burst excitation

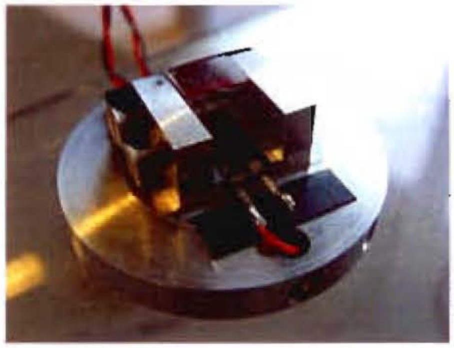
Opt. Express **18,** 4212–4221 (2010)

Photoacoustic imaging has recently garnered much attention as it offers high optical contrast and spatial resolution, making it ideal for a number of biomedical applications, including blood flow analysis. Now, Adi Sheinfeld and colleagues from Tel-Aviv University in Israel have extended the application of photoacoustic imaging to measure flow and particle position based on the Doppler effect using tone burst excitation. The use of burst excitation allows the researchers to simultaneously obtain information on the spatial positions of the particles as well as their velocities, an important benefit. The researchers used heterodyne detection to measure the flow rate of a suspension of carbon particles in a 3 mm transparent silicon tube. The technique was able to measure data for mean particle velocities of up to 130 mm s^{-1}, over 10 times as high as the capability of previously reported photoacoustic Doppler apparatus. The team predicts that their method should extend to even higher velocities in the future.

BIOPHOTONICS

Monitoring heart rate

Opt. Express **18,** 4867–4875 (2010)



Doctors often rely on a diagnostic technique known as photoplethysmography (PPG) for continuous monitoring of vital signs such as heart rate and blood oxygenation in patients. In most cases, contact PPG — in which sensors and light sources are in contact with the skin — is a suitable option. However, this technique is not ideal in situations where patients suffer from sensitive or damaged skin, or where movement is unavoidable. Now, Giovanni Cennini and co-workers from the Netherlands, France and Germany have developed a device that efficiently monitors heart rate in real time through remote PPG, while reducing any motion artefacts in the signal. The researchers were able to collect light signals using a compound parabolic concentrator and two photodiodes with associated wavelength filters. Two separate signals were obtained through a dual-wavelength illumination technique: the PPG signal containing motion artefacts (obtained with blue light) and a signal proportional to the motion of the skin (obtained with infrared light). The heart-cycled component of the PPG signal was then amplified, and an adaptive echo cancellation algorithm was implemented to subtract the motion-caused irregularities from the PPG signal, allowing for an accurate heart rate calculation. The team expects that this dual-wavelength technique will be applied in all future efforts in developing remote PPG.