# Middle Infrared Spectroscopy of Atherosclerotic Plaque

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**The project:** Cardiologists are looking for an *in vivo* diagnostic tool which will enable an accurate identification and characterization of the plaques that are vulnerable to rupture (i.e. "vulnerable plaque") in patients. The most critical information needed for the accurate determination the clinical severity and the reliable prediction of future recurrence of acute coronary syndromes in patients is the characteristics of the chemical composition of the plaques. Spectroscopy in the mid-IR in the spectral range 3-30 μm is a particularly useful for the study of tissues and for distinguishing between diseased and healthy tissues. The use of optical fibers which are transparent in the mid-IR makes it possible to carry out spectral measurements in an area remote from an IR spectrometer. It is proposed here to carry out such measurements on atherosclerotic plaque *in situ* (and *in vivo*) in an attempt to detect features which will reveal changes within atherosclerotic plaque. This method will be an important diagnostic tool at the hand of the interventional cardiologists. Such a method will also be highly important in preventive cardiology.

**The requested equipment:** The infrared fiberoptic spectroscopy system that we use is based on special AgClBr optical fibers, made by the Applied Physics Group, and on a tunable IR source. In order to carry out measurements on atherosclerotic plaque, there was a need for a tunable IR source of much higher intensity than was available at TAU. The most appealing source available commercially was the tunable Quantum Cascade Laser which emits in the middle infrared with power levels of several mW. We then found that a tunable $CO_2$ made by the Scottish Company Edinburgh would be even more suitable. We managed to obtain partial funding from the Head of the School of Physics and from the Dean of the Faculty of Exact Sciences, and this funding, together with the generous funding from the Slezak Foundation we placed an order for a powerful $CO_2$ laser which costs £16000. This $CO_2$ laser emits 60 lines in the range 9.6-11.6 μm and it would be most suitable for Mid-IR spectroscopy of plaque.

**Operation of the equipment**: The circumsances around the purchase order were highly unusual. At first there were delays in sending the purchase order to Scotland. Then Edinburgh had difficulties in manufacturing this special laser. The laser arrived in Israel almost a year after the purchase order was made. When the laser arrived it did not work and it had to be sent back to Edinburgh for repair. After a couple of months it was sent back and this time it did work, but the power emitted was very low. It took our students ( with the help of Edingurgh) a couple of months before the laser finally operated well. This happy event happened towards the end of the the summer of 2009. Now we are running tests on the laser and trying to use it for spectroscopic applications.

**Experiments:** Now that the laser is working well we plan to carry out the experiments that we had planned to perform more than a year ago. We will obtain plaque samples and test their absorption in the middle infrared *in vitro*. We will try to use the results to characterize the plaque. We hope that this will lead to clinical applications of the method (even *in vivo*).