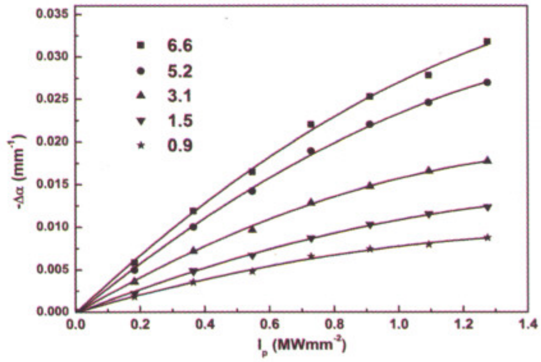

Fig. L.8.2. The change in the absorption of the sample for different pump intensities. Legend shows the volume fraction of the sample in units of 10^{-6}.

In Fig. L.8.3 we show the estimated imaginary part of third-and fifth-order nonlinearity of the silver nanoplatelets in water. Effect of pump depletion in the sample has been taken into account to correctly estimate the nonlinearities of the sample.

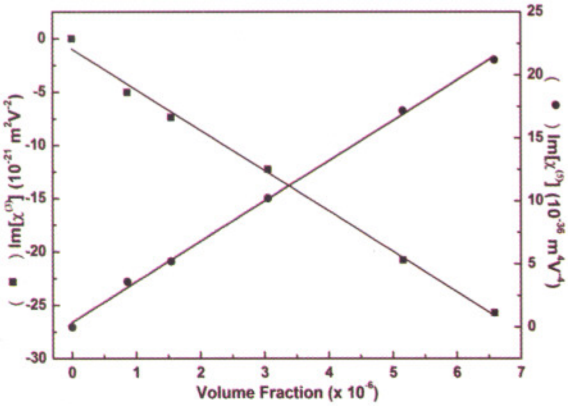

Fig. L.8.3. The dependence of third- and fifth-order nonlinearities of silver nanoplatelets in water with its volume fraction. The solid lines are the linear fit to the data.

Our results show that in low volume fractions both third- and fifth-order nonlinearities of nanoplatelets measured near one of its LSPR peak depends linearly on the volume fraction. These results are important to understand the transient nonlinear response of nonspherical nanoparticles.

Reported by:
J. Jayabalan (jjaya@rrcat.gov.in)
Asha Singh and Rama Chari

L.9: Development of a sensitive and high dynamic range laser energy meter

A sensitive and high dynamic range photo diode based laser energy meter was developed in Laser Physics Applications Division of RRCAT. The essential blocks of the energy meter are the photo detector circuit, the signal conditioning circuit and the capacitor discharge circuit. The photodiode converts the incident laser pulse into an electrical current pulse. This pulse current charge an energy sensing capacitor connected in series with the photodiode. The magnitude of the energy sensing capacitors 470 nf, 47 nf, 4.7 nf and 4.7 pf, are selected manually by a rotary switch depending on the input energy of the laser. A large resistor of 1 MΩ is connected in parallel with the energy sensing capacitor for low droop rate. For the input energy of about 12 μJ, the energy sensing capacitor of 470 nf was selected. The lowest value of the energy sensing capacitor of 4.7 pf was selected to measure the energy in the range of nJ. The signal pulse obtained with 4.7 pf was further amplified by an instrumentation amplifier AD524 to detect even the lower laser energy signals. The gain of the instrumentation amplifier can be selected from 1× to 1000× in steps of ten by a PCB mounted DIP switch. The energy meter requires ±15 V for its operation. Minimum energy of a few pJ is measured with the combination of an energy sensing capacitor of 4.7 pf and a gain of 1000 from AD524.

The signal conditioning circuit provides the buffer and the gain to the signal pulse obtained from the photo detector circuit. The output electrical pulse from the photo detector circuit was buffered by an operational amplifier buffer LF356 and was fed into the instrumentation amplifier AD524. The output of the instrumentation amplifier was buffered by an operational amplifier buffer LF356. The output voltage pulse from this buffer was measured on a Tektronix TDS2024B oscilloscope. The peak of this pulse was proportional to the incident laser pulse energy.

The long discharge time constant of the energy sensing capacitor limits the measurement of energy of the laser pulses at high repetition rate. The fast capacitor discharge circuit is therefore incorporated. A toggle switch in the signal conditioning circuit was kept 'ON' to enable the capacitor discharge circuit. The capacitor discharge circuit comprised of IC's, comparator LM311, monostable multivibrator 4047, buffer 4050 and a reed relay. It may be noted that the normally open contact of the relay is connected in parallel with energy sensing capacitor through a 100 Ω resistor. The output from the signal conditioning unit buffer was applied to the inverting input of the comparator. The other input to the comparator was kept at 60 mV dc, to avoid a possible comparator output due to noise. As soon as the photo detector output signal at the inverting input of the comparator crosses 60 mV, the comparator output changes from high to low. This eventually energies the relay after appropriate delay to discharge the energy sensing capacitor through 100 Ω resistance instead of large 1 MΩ resistor. The energy of the laser pulses up to a repetition rate of about 300 Hz can be measured, which is limited by finite operate time of relay.

The effective dynamic range of the energy meter was measured by a Q-switched Nd: YAG laser pulses of about 30 ns operating at the wavelength of 532 nm. The energy measurements were performed over the pulse repetition frequency from a single shot to about 10 Hz. The high frequency operation of the energy meter was limited by the laser. The signal recorded by the photodiode energy meter was plotted as a function of the input laser energy for different values of energy sensing capacitors (Fig L.9.1). The calibration factor for each range was obtained. The energy from the photodiode energy meter can be obtained by recording the peak voltage from the oscilloscope and the calibration factor. The squares in fig. L.9.1 show the plot between the energy recorded by the photodiode energy meter as a function of the input laser energy. The experimental data were fitted to a straight line passing through the origin. The maximum and the minimum detectable laser energy falling on the photodiode energy meter in the linear regime are about 12 μJ and 2 pJ respectively, which correspond to a dynamic range of about 6 × 106. For a given energy sensing capacitor, the error between the measured energy and the fitted value is about ±6% for the energy meter output voltages recorded between 5 and 0.25V.

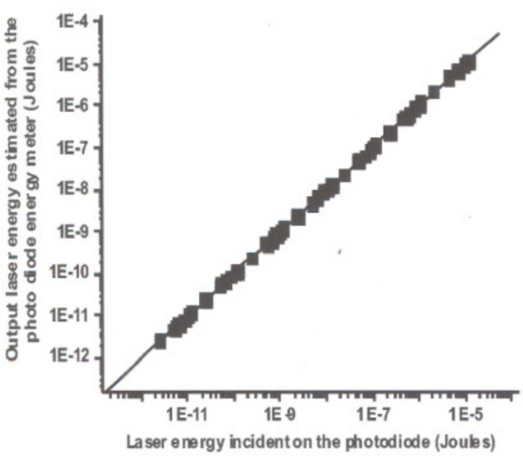

Fig.L.9.1 The graph showing the output of the energy meter as a function of the input energy.

Reported by:
S. Krishnan and K.S. Bindra (bindra@rrcat.gov.in)

L.10: Investigation of Glass to Metal Seal on ambient oxidized Kovar surface

Glass to metal (GM) seal is an important component having wide applications in various disciplines of science and engineering. Kovar alloy is the most widely used material for making matched glass to metal seals. Sealing surface of the Kovar must be initially oxidized. This facilitates wetting by molten glass and subsequent chemical bond formation resulting in a strong and vacuum tight glass to metal seal. The nature and thickness of oxide layer is important to produce a high quality glass to metal seal.

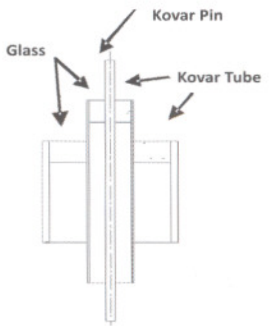

Fig .L.10.1 Coaxial glass to metal feed through with mounting flange

Oxidation of Kovar sample plates was done using LPG flame in ambient condition. The time of oxidation was 5, 20, 30, 50, 60 and 120 seconds. Following the same fabrication cycle a coaxial GM seal was made for capillary discharge system in Laser Plasma Division.

Characterization of the oxidized Kovar sample and GM seal were done as given below:

- X-ray Diffraction (XRD) with CuK_α (1.54°A)
- Optical microscopy
- Scanning Electron Microscopy (SEM) with Energy-Dispersive Spectroscopy (EDS)
- Leak Testing using He leak detector.

The XRD results shown in fig L.10.3 indicated limited oxidation on specimen oxidized for 5 seconds; significant oxidation was seen in all samples oxidized for 20 seconds and more. Further, the oxide layer on Kovar surface comprised of Fe_3O_4 and γ-Fe_2O_3, α-Fe_2O_3 was observed only after 120 seconds of oxidation.