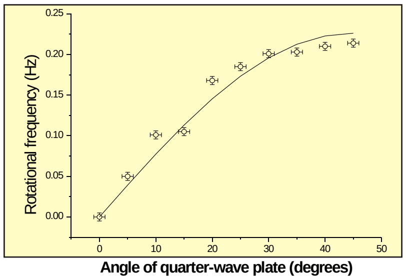

Fig. L.8.2 *Variation of rotational frequency with changing angle of the quarter-wave plate*

of the beam. The ellipticity of polarization of the trap beam was changed by placing a quarter-wave plate in the path of the trapping beam and changing the orientation of its fast axis with respect to the polarization plane of the beam. [R Dasgupta and P K Gupta, to appear in Opt. Lett.].

(Contributed by: R. Dasgupta and P. K. Gupta; pkgupta@cat.ernet.in)

L.9 All-optical switching with metalloporphyrins

Considerable research efforts are directed towards all-optical molecular devices for information processing and storage that offer advantages of small size and weight. Metalloporphyrins are interesting chronophers due to their large nonlinearity and amenability to tailoring of their properties by different techniques to develop better materials for device applications. Vanadium (IV)-oxide tetraphenylporphyrin (VOTPP) and Zinc (II) tetraphenylporphyrin (ZnTPP) show enhanced nonlinear optical properties. All-optical switch is a fundamental building block of information processing for future.

All-optical switching experiments were performed in ZnTPP and VOTPP in toluene solution using pump probe method. A He-Ne laser of 633nm was used as probe beam and a flash lamp pumped frequency doubled Q-switched Nd:YAG laser of 532nm, 20ns pulse width was used as the pump beam. Fig. L.9.1 (a) and (b) show all optical switching characteristics of ZnTPP and VOTPP, respectively. Switch 'off' and 'on' time for ZnTPP are ~200ns and ~3.5μs respectively and for VOTPP respective times are ~1.5μs and ~2.5μs. Further, the effect of variation of pump energy on transmitted probe beam intensity for different concentrations of VOTPP was also studied. Results indicate that there is an optimum value of concentration (43% linear transmission at 532 nm) for which maximum modulation of the probe beam (~30%) was achieved with 1.1 mJ pump energy. Fig. L.9.1 shows larger fall time of VOTPP in comparison to ZnTPP. Rate equation approach was used to analyze the observed switching characteristics of ZnTPP and VOTPP. Theoretical switching curve for ZnTPP, using three states model, was in good agreement with the experimental result. However, for VOTPP the comparison of switching dynamics obtained by theoretical simulations and experimental data pointed out the possibility of existence of an intermediate state, so called charge transfer state with ~1.5μs lifetime.

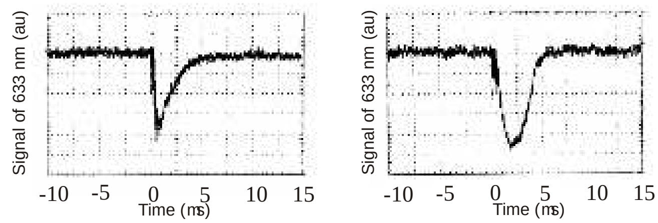

Fig. L.9.1 All-optical switching in (a) ZnTPP and (b) VOTPP.

Since the kinetic and spectral properties of metalloporphyrins can be tailored by different means, the switching characteristics can be optimized for desired applications. In an ideal case, where the probe beam does not get absorbed by the ground state, complete switching (100% modulation of the probe beam) can be achieved by increasing the input intensity. The switching operation can be made fast by decreasing the lifetime of triplet state. Metalloporphyrins based switches would be potentially useful in optical signal processing. They can provide an alternative to the thermo-optic, MEMS, and liquid crystal switches that operate in the μs range.

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L.10 Laser surface treatment enhances localized corrosion resistance of austenitic stainless steel

Austenitic stainless steels (ASS) are susceptible to localized corrosion in chloride bearing environment. Super ASS with high concentrations of Cr (≈ 25%) and Mo (≈ 6.5 %) exhibit superior corrosion resistance than the popular 18/8 variety of SS. Surface alloying of ASS with Cr and Mo, therefore, offers an economical means of enhancing corrosion resistance of relatively cheaper 18/8 stainless steel.

With this objective in mind, laser surface alloying experiments were carried out with indigenously developed 2.5kW CW CO_2 laser. The modification of surface chemical composition of type 304L SS was effected by laser deposition with pre-mixed powders of type 316L SS and Cr. For controlling ferrite content arising out of Cr alloying, laser deposition was also performed with premixed powders of type

316L SS, Cr and Ni. Type 316L SS powder was selected (in preference to type 304L SS) for achieving surface alloying with Mo. Table 1 presents chemical composition of laser surface alloyed specimens, as determined by EDXRF. The results of potentiodynamic polarization study performed on laser surface treated as well as on type 304L SS substrate in 0.5M NaCl solution demonstrated excellent beneficial effect of laser surface alloying (fig L.10.1). Pitting potential of laser treated specimen alloyed with Cr & Mo registered a significant increase from 310mV to 720mV. On the other hand, surface alloying with Cr, Mo and Ni served to further rise pitting potential to 980mV. Impedance tests exhibited that Cr, Mo and Ni alloyed specimen had highest polarization resistance followed by Cr & Mo alloyed specimen while untreated substrate registered lowest polarization resistance. The capacitance of Cr, Mo and Ni alloyed specimen was lowest followed by that of Cr and Mo alloyed specimen and untreated substrate.

Table 1: Chemical composition (in wt%), as determined by EDXRF

Specimen	Targeted composition	Actual Composition				
		Cr	Ni	Mn	Mo	Fe
SUBSTRATE		19.48	10.68	1.08	1566 ppm	67.99
CR & MO ALLOYED	CR : 25-30; NI: 8-10; MO : 1.5; FE: BAL	24.23	9.04	0.63	2.06	64.05
CR, MO & NI ALLOYED	CR: 25-30; NI: 25-30; MO : 1.5; FE: BAL	24.42	21.72	0.27	1.37	52.22

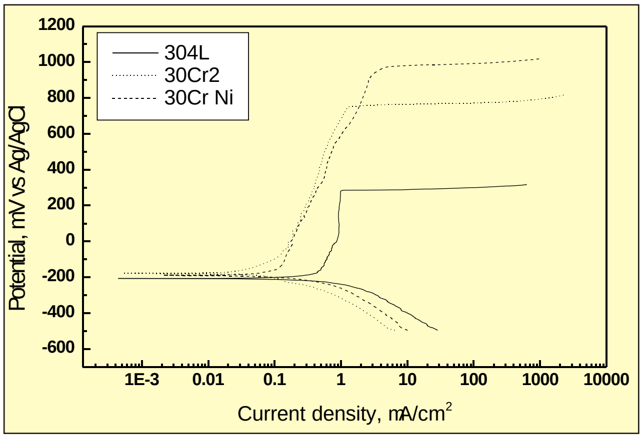

***Fig. L.10.1** Potentiodynamic polarization curves of laser treated specimens and the substrate in 0.5M NaCl solution. (304 L substrate; 30Cr2 - Cr & Mo alloyed; 30CrNi Cr, Mo & Ni alloyed)*

(Contributed by A.K. Nath, aknath@cat.ernet.in)

L.11 Laser alloying produces corrosion-resistant surface for HNO_3 environment

Type 304L austenitic stainless steel (SS) is a major material of construction in chemical and reprocessing plants involving extensive use of HNO_3. Normally protective Cr_2O_3 film on the surface of SS is rapidly dissolved when acid concentration rises beyond 8 N or its temperature rises above 353 K. The stability of Cr_2O_3 film is enhanced by addition of Cr and Ni. Si is another important alloying element influencing corrosion resistance of ASS in HNO_3 environment. Si offers excellent corrosion resistance when its concentration is either below 0.2 wt% or above 1.6 wt%. With 0.4-1 wt% Si content, the alloy suffers excessive inter granular corrosion [A.J. Sedricks, Corrosion of Stainless Steels, John-Wiley and Sons, New York 1979]. ASTM specifications allow up to 1 wt% Si in type 304L SS. Hence, surface enrichment of Si above 1.6 wt% offers an effective way to enhance corrosion resistance of type 304L SS in concentrated boiling HNO_3 environment.

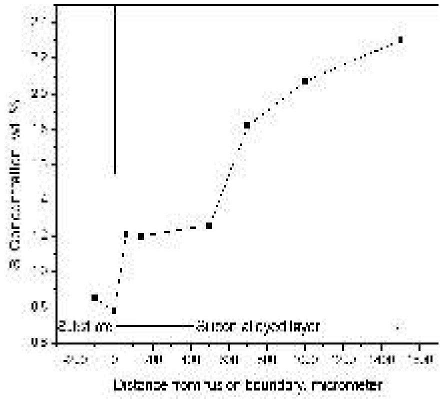

***Fig. L.11.1** Si concentration profile across the cross-section of laser alloyed specimen*

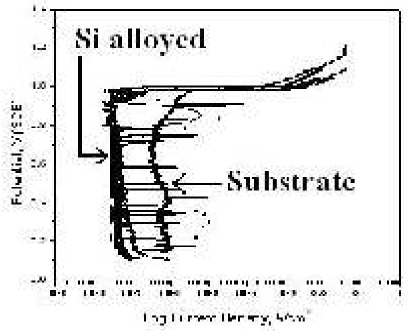

***Fig. L.11.2** Potentiodynamic polarization curves of substrate and silicon alloyed samples*