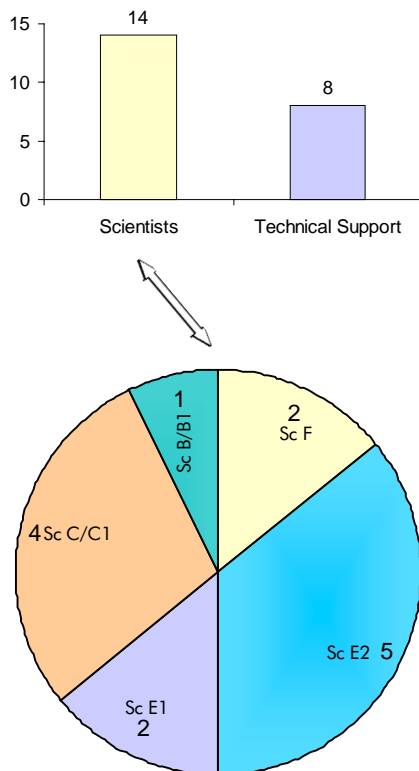


## SURFACE ENGINEERING DIVISION

### SUMMARY

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Applications of surface engineering (SE) are many and varied. The Surface Engineering Division (SED) has been making contributions to aerospace, energy, transport and general engineering sectors. Several interesting developments in these areas have been made this year and these are highlighted below.

SED has successfully developed sunshield mirrors for VHRR for INSAT class of satellites (INSAT 2A, 2B, 2E and 3A). Now ISAC is interested in the development of sunshield mirrors for INSAT 3D. The methodology however is different. A single point diamond turned aluminium alloy surface has to be given a nanocrystalline coating of nickel alloy which can be polished to very high accuracies of the order of 10-20 Å.

Preplating conditions were evaluated and standardized for getting uniform and adherent amorphous nickel coating on aluminium alloy. These coated panels were polished at Indian Institute of Astrophysics and the results indicate that the coating is quite adherent and the mirror quality conforms to specifications.

The binary paint (NAL-G) developed last year exhibited very good pressure sensitivity and a low temperature coefficient. However, in wind tunnel studies, it showed some degradation. Hence efforts were made to improve the stability of the paint. This resulted in the development of two paints: NAL G-1 and NAL G-2 and their complete characterization.

In NAL G, a commercially available binder was used. The uncertainty in the availability of this resin in the market is a serious concern. Hence, a systematic study was carried out with different commercially available binders and this evaluation helped in selecting a few more promising candidate binders for future work.

Fabrication of embossing rollers are at the final stages of fine turning. At the request of ITC, the rollers, with an increased length of 100 mm were profile ground on the newly acquired longer stroke Pe Te Wee optical profile grinder at Perfect Profiles. The rollers were surface hardened by plasma nitriding. The rollers were assembled on the production machine. These have been continuously running on the production line for the past one and a half month without any problem and the embossing made with these rollers is extremely good and comparable to imported rollers.

The electrochemically assisted arc machining process was demonstrated with the industrial prototype machine. Machining trials were carried out on several difficult to cut materials like SS, Inconel, carbides, etc. The process parameters such as feed rate, band speed, voltage, current and flow rate have been established for optimising the machining conditions.

A chemical milling process was successfully developed for taper milling of spar tubes of helicopters. The tapering should be continuous and should not be in steps. The

reproducibility of tapering should be extremely good. The chemical milling process should produce a smooth surface without pits or voids and also without affecting the mechanical properties of the substrate material. All these challenges were met and the chemical milling process was demonstrated on 1/6<sup>th</sup> model and was accep-

ted by HAL. We have initiated action on the technology transfer to HAL.

After completing studies on the metal/metal multilayer superlattice coatings, work on ceramic/ceramic multilayer systems has been initiated. Conditions have been standardized for getting adherent ceramic coatings on a silicon

substrate by reactive sputtering and the characterization of the coatings is in progress.

Systematic investigations were also carried out on the effect of additives on the internal stress of electrodeposited copper using the stress meter developed at SED.