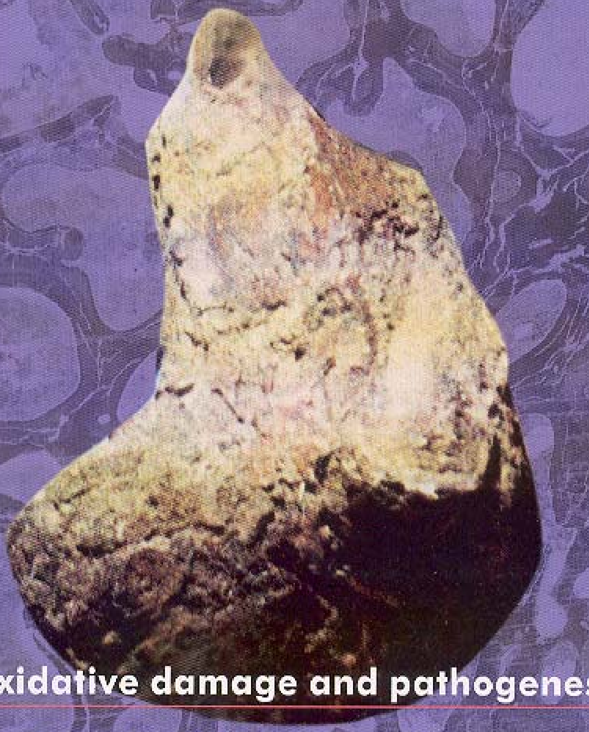
Volume 77 Number 5

10 September 1999

CURRENT SCIENCE



Oxidative damage and pathogenesis

Lead in the Delhi iron pillar

Antifungal drug response

Current Science Association ■ Indian Academy of Sciences

as obtained from TEM) with a high polymer concentration employing a red and a green band pass filter. The image clearly shows contribution in both the spectral regions. A real colour image constructed from these components is shown in Figure 4 *a*. The general trend is that the circular regions are primarily red with yellow contribution appearing at the periphery and outside the circular region. Another feature observed is the decrease of area with the yellow component in films with lower polymer concentration as shown in Figure 4 *b*. Far field photoluminescence spectral response of these films is consistent with the optical microscope images as shown in Figure 4 *c*. Apart from the normal PL contribution from the polymer with a $\lambda_{max} \sim 680$ nm, a distinct blue-shifted component yielding responses in the region 520 nm $< \lambda < 600$ nm is present. The 680 nm centred emission is the expected singlet exciton radiative decay of the regio-regular polymer[6]. A blue-shifted emission can arise from subtle changes in the polymer orientation, conformation or packing density due to the presence of the nanoparticles leading to changes in the electronic structure. A more direct change in the electronic density can occur if the interaction between the Au nanoparticles and the polymer interaction is appreciable, leading to charge transfer. Detailed spatially resolved fluorescence measurements are in progress along with high resolution TEM studies to probe the novel properties and unique patterns of the composite films. The fluorescence stability of the polymer in the nanoparticle environment is also being probed along with FTIR studies.

In conclusion, novel morphological and fluorescent features were observed in Au nanoparticle–P3OT composite films. The features varied with the relative concentration of the polymer with respect to the nanoparticle. The difference in the PL spectra of the blend and the pristine polymer is indicative of an interaction between the polymer and the nanoparticles.

1. Burroughs, J. H., Bradley, D. C., Brown, A. R., Marks, R. N., Mackay, K., Friend, R. H., Burn, H. and Holmes, A. B., *Nature*, 1990, **347**, 539.
2. Tessler, N., Harrison, N. T. and Friend, R. H., *Adv. Mater.*, 1998, **10**, 64.
3. Kreibig, U. and Vollmer, M., *Optical Properties of Metal Clusters*, Springer Series in Materials Science-25, 1995.
4. Brousseau III, L. C., Novak, J. P., Marinakos, S. M. and Feldheim, D. P., *Adv. Mater.*, 1999, **11**, 447.
5. Brust, M., Walker, M., Bethel, D., Schiffrin, D. J. and Whyman, R., *J. Chem. Soc., Chem. Commun.*, 1993, 96.
6. Chen, T.-A., Wu, X. and Rieke, R. D., *J. Am. Chem. Soc.*, 1995, **117**, 233.
7. Ohara, P. C., Heath, J. R. and Gelbart, W. M., *Angew. Chem., Int. Ed. Engl.*, 1997, **36**, 1077.

ACKNOWLEDGEMENTS. We acknowledge the valuable guidance of Prof. C. N. R. Rao during the entire project. We also thank Dr S. Meyer and Mr R. Sharma for confocal microscope measurements.

Received 8 July 1999; revised accepted 21 July 1999

Some aspects of presence of lead in the Delhi iron pillar

R. Balasubramaniam

Department of Materials and Metallurgical Engineering,
Indian Institute of Technology, Kanpur 208 016, India

Some aspects related to the presence of lead in the Delhi iron pillar are presented in this communication. The presence of a lead solder in the joint between the decorative bell capital and the main body of the Delhi iron pillar has been confirmed by X-ray diffraction analysis of the corrosion product obtained from the joint region. The corrosion products were unambiguously identified as lead carbonate hydroxide hydrate $PbCO_3.Pb(OH)_2.H_2O$ and lead oxide carbonate Pb_2CO_4. The use of lead-based solders in joining the Delhi iron pillar's main body with the decorative bell capital is clearly established. The galvanic corrosion of iron in a lead–iron couple in soil and aqueous (3.5% NaCl solution) environments has also been studied in order to understand the nature of corrosion of the Delhi iron pillar in the buried underground regions. The corrosion of iron in soil was higher than that in the aqueous solution and the iron covered with larger area fraction of lead was corroded to a greater extent in both the environments. Severe localized corrosion of iron was observed at the defects in the lead coating. Based on the simulation experiments, it is concluded that the iron in the buried regions of the pillar is subject to severe localized corrosion due to the presence of lead coating in this region. It is recommended that the lead coating be removed and replaced with a zinc coating for the long-term preservation of the Delhi iron pillar.

THE Delhi iron pillar situated in the *Quwwat-ul-Islam* mosque complex near the Qutub Minar at New Delhi, India is widely popular for its excellent resistance to corrosion. It is a classic product of the forge welding technique used by ancient Indians to manufacture large iron objects. The material of construction of the pillar is almost pure iron with entrapped slag inclusions, which result due to the process of extraction of iron. There are several studies reported in the literature on the corrosion resistance of the pillar[1–3]. The history of the pillar[4,5], its dimensional analysis[5,6], its decorative bell capital[6] and the possible manufacturing technology employed to construct the pillar[7] have been addressed earlier. The presence of lead at several locations on the pillar has been recently addressed in detail[8] wherein visual evidences were presented. The presence of lead sheet at the bottom of the pillar is known from excavation reports[9,10]. The presence of lead appearing as black fillings between some of the iron lumps can be easily noticed on the surface of the

---

e-mail: bala@iitk.ac.in