SPIRAL GROWTH OF LEAD ON A COPPER (111) PLANE

SPIRAL growth during electrocrystallization when substrate and the deposited metals are the same, *e.g.*, copper[1,2] and silver[3] have been reported. Spiral growth is also observed when titanium is electrodeposited from molten salt[4] and during electrodeposition of silver-indium alloy[5]. So far no spiral growth is noticed during electrocrystallization when substrate and deposited metals are different. If the lattice misfit of the substrate and deposited metal is less than 14% there is epitaxial growth at least in thin deposits[6]. Both copper and lead are f.c.c. metals and the misfit for the case of {100}Cu//{100} Pb matched on (100) planes is 36·8%. Similarly {111}Cu/{111}Pb is 36·8%[7]. Generally it is expected that there would be no epitaxial growth of lead on copper. However Sang *et al.*[7] have grown lead single crystals on the copper single crystal seeds from liquid pairs and have found that epitaxial lead crystals grow in the same crystallographic orientation. It is found during the literature survey that lead has not been electrodeposited on either polycrystalline or single crystal copper substrates. So it is felt that it would be interesting to electrodeposit lead on a single crystal of copper (111) plane.

The copper single crystal was fixed in a tygon tubing such that only (111) plane was exposed. This crystal was electropolished in 1 : 1 orthophosphoric acid bath[8] and lead was deposited from a saturated ($\approx 1 \cdot 7$ M) lead nitrate solution at various current densities in a three compartment cell[9]. The deposition was carried out at a particular current density and after a passage of 2 C/cm^2 the crystal was taken out and washed with distilled water and alcohol. The dried surface was examined under optical microscope and photomicrographs were taken.

It was found that lead started depositing at the edges of the copper crystal plane when current density was 1 mA/cm^2. As the current density was increased, more and more surface of the crystal plane was covered and at 8 mA/cm^2 a uniform deposit was observed. Triangular spirals were observed even when the lead got deposited at the edges. Most of them were too faint to be photographed. Occasionally very well-defined triangular spirals were observed (Fig. 1). When the current density was increased, the distance between the consecutive steps decreased as was observed in the case of silver[3]. Further it was also noticed that very symmetrical hexagonal spirals (Fig. 2) began to grow along with triangular spirals as the current density was increased. The spiral growth was highly reproducible.

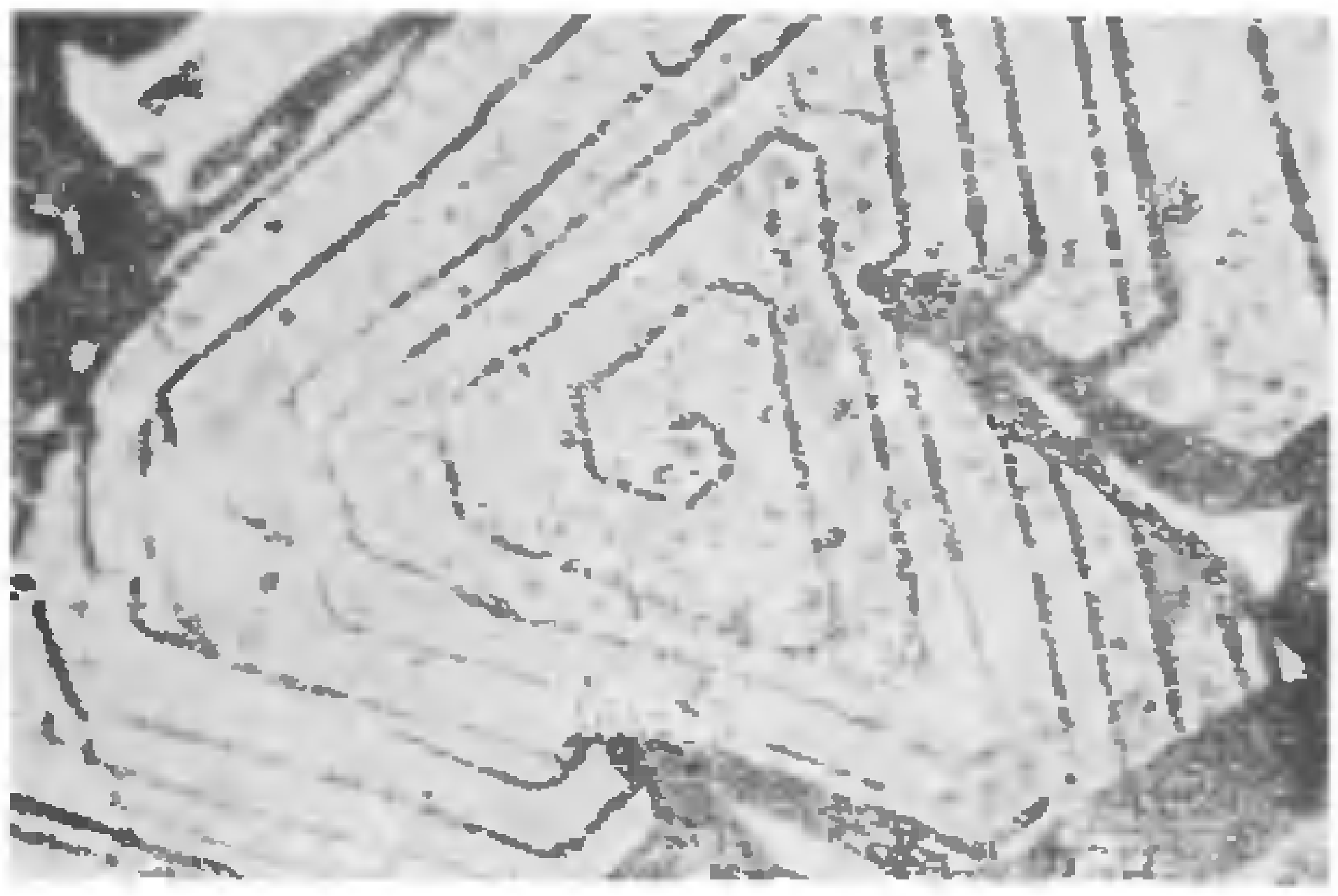

FIG. 1. Deposition of lead on a copper (111) plane from saturated lead nitrate solution at 1 mA/cm^2, $\times$ 600.

FIG. 2. Deposition of lead on a copper (111) plane from saturated lead nitrate solution at 8 mA/cm^2, $\times$ 600.

The above facts indicate that electrodeposited lead grows epitaxially on the copper (111) plane. It is known that larger misfits between the lattices of two metals produce the source of dislocations[10]. If these are screw dislocations the spiral growth of lead crystals could be explained in the light of Frank's theory[11] of crystal growth.

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1. Pick, H. J., *Nature, Lond.*, 1955, 176, 693.
2. Seiter, H., Fischer, H. and Albert, L., *Naturwiss.*, 1958, 45, 127.
3. Kaishev, R., Budevski, E. and Malinovski, I., *Z. Physik. Chem.*, 1958, 204, 348.
4. Steinberg, M. A., *Nature, Lond.*, 1952, 170, 1119.
5. Raub E.Mitt. Forsch, *Inst. Probieramts. Edelmetalle Fachschule Schwab Gmund*, 1938, 12, 55.
6. *Structure of Metals*, C. Barret and T. B. Massalski, McGraw-Hill, 1968, p. 538.
7. Sang, H., Miller and William Alfred, *J. Cryst. Growth*, 1970, 6 (4), 303.
8. Jacquet, P. A., *J. Metal Finishing*, 1949, 47 (5), 49.
9. Nageswar, S. and Setty, T. H. V., *Proc. Indian Acad. Sci.*, 1968, 67, Sec. A, 178.
10. Bockris, J. O'M. and Despic, A. R., In *Physical Chemistry*, Ed., H. Eyring, D. Henderson and W. Jost, Academic Press, London, 1970, p. 668.
11. Frank, F. C., *Disc. Farad. Soc.*, 1948, No. 5, 48.

STORAGE STABILITY OF ANTIMICROBIAL COTTON TEXTILE

CELLULOSIC materials are extremely susceptible to microbial attack. This is deleterious for the clothing and also may function as a source of microbial infection to the user particularly in the tropical climate. Many attempts have been made by several workers to impregnate certain chemicals in cotton textile to render them free from microbial attack, *e.g.*, halogenated benzazole derivatives[3], alkyl dimethyl benzyl ammonium chloride[8], neomycin sulphate[7] and T.H.P.C. melamine, etc. Antibacterial finishes have been imparted by various techniques such as fibre reaction, resin bonding[2], and thermosetting bacteriostatic resins[5], etc. Similarly pentachlorophenol can be chemically attached to lignocellulosic fibres in water suspensions by a bridge derived from cyanuric acid.

With this view, a few chemically treated antimicrobial cotton textiles were prepared in an effort to find an effective fabric to prevent deteriorations due to micro-organisms. One such treatment was reported by Ghose and Maurya (1971)[1] which consists of polymerising *in situ*, a urea-mercury compound (0·1% aq. solution) (w/v) with neutral-formaldehyde and final baking at 130° C for half an hour. Storage stability tests on the treated samples are reported here.

The samples prepared in June 1969, July 1970 and May 1971 were stored in a steel cabinet and their antimicrobial properties evaluated after three, two and one year of storage respectively. Antimicrobial studies were carried out immediately after: (*i*) the preparation of the control samples; (*ii*) 25 washings; (*iii*) 3 hr boiling and (iv) 24 hr leaching. The samples exhibited remarkable antibacterial activity which persists even after various conditionings of the treated textile materials.

Antibacterial activity of the treated samples stored under ambient conditions are reported in Table I.

TABLE I

Antibacterial activity of cotton textiles treated with urea formaldehyde mercury compound (0·15)*

S. No.	Organisms used		Samples prepared in June 1969	Samples prepared in July 1970	Samples prepared in May 1971
1	*Salm. typhi*	..	23·40	23·98	23·55
2	*Strept. faecalis*	..	23·27	38·37	38·97
3	*Staph. aureus*	..	28·50	28·73	30·88
4	*Staph. albus*	..	25·50	28·68	29·30
5	*Strepto. pyogenes*	..	29·00	34·17	38·85
6	*Bac. pumilus*	..	24·15	27·36	28·20
7	*Bac. subtilis*	..	Traces	25·97	22·75
8	*Pseudo. pyocyanea*	..	30·95	34·12	36·85

* (i) Average of three readings; (ii) Zone of inhibition expressed in mm.

In yet another study samples of cotton textiles were prepared by dipping them in 2% acinol (a proprietary product of Ahura Chemicals, Bombay) solution and drying in open air. The samples were prepared in February 1971. Follow-up studies revealed excellent antibacterial properties which, however, diminished on washing. Acinol (Cetyl Dimethyl Benzyl Chloride (CDMB-100) was originally prepared as a textile detergent which Rao *et al.*[6] have established as a potent antimicrobial and antiseptic agent.

The antimicrobial properties of acinol treated samples were assessed after one and half years of similar ambient storage in a steel cabinet. The observations are recorded in Table II.

TABLE II

Antibacterial activity of cotton textiles treated with 2% acinol CDML-100**

S. No.	Organisms used		Samples prepared in February 1971
1	*Salm. typhi*	..	34·32
2	*Strept. faecalis*	..	33·87
3	*Staph. aureus*	..	30·09
4	*Staph. albus*	..	31·48
5	*Strept. pyogeneus*	..	34·25
6	*Pseudo. pyocyanea*	..	30·10
7	*Bac. subtilis*	..	30·52
8	*Bac. pumilus*	..	27·62

* (i) Average of three readings; (ii) Zone of inhibition expressed in mm.