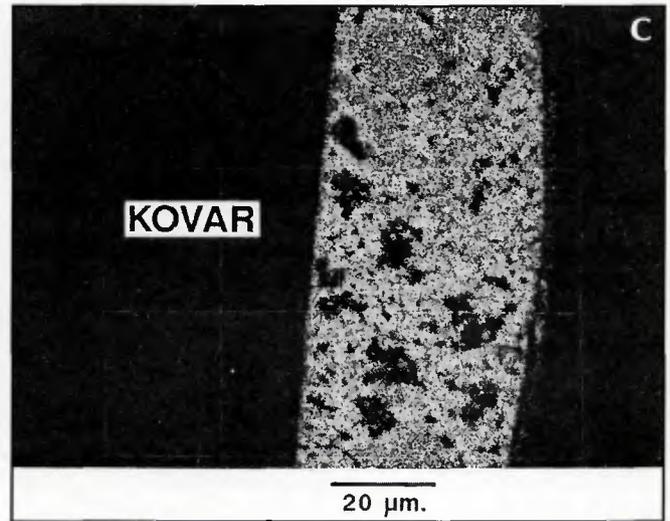
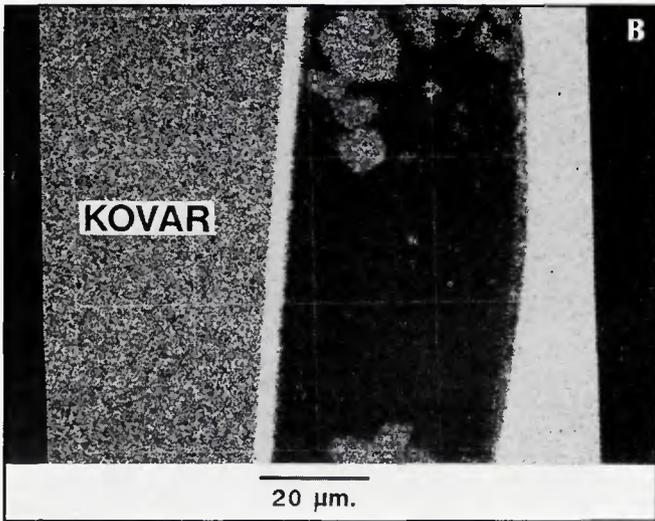


Fig. 10—A—SEM micrograph (backscattered electron) of the solder film cross-section on Ni-plated Kovar (Flux D, 260°C). The Kovar coupon is to the left of the film. B—x-ray map of the nickel concentration of the micrograph in A. C—x-ray map of tin.



**Effect of Flux Dilution**

Flux D (OA-H<sub>2</sub>O) was selected to determine the effect of flux dilution. The plain Kovar coupons were chemically etched (after a 20 s diluted sulfuric acid etch to remove a heavier than normal oxide). Shown in Fig. 11 is a graph of the contact angle and solder-flux interfacial tension as a function of the degree of dilution of the flux. The behavior of  $\theta_C$  followed closely that of  $\gamma_{LF}$  with a minimum at 50 to 60% dilution. The values of the parameter,  $(\gamma_{SF} - \gamma_{SL})$ , did not contribute to the overall trend of  $\theta_C$ . The wetting rate,  $W$ , and the value of  $\theta_C$  showed no significant dependence on the degree of dilution.

**Effect of Solder Temperature**

Contact angle as a function of the solder bath temperature for plain Kovar samples coated with Flux A (RMA) or Flux D (OH-H<sub>2</sub>O) is shown in Fig. 12. The specimens received the electropolishing treatment. A small decrease in contact angle with increasing temperature was ob-

served for the samples fluxed with D. A slope of  $-0.08 \text{ deg}/^\circ\text{C}$  and a correlation coefficient ( $R^2$ ) of 0.74 were measured by a linear least squares analysis of the data. For the RMA Flux A, a correlation coefficient ( $R^2$ ) of 0.27 confirmed no statistical dependence of  $\theta_C$  on temperature over

the range tested. Samples of the wetting curves from tests using both fluxes and solder temperatures of 215° and 245°C are shown in Fig. 13. The solderability results are listed in Table 4. With the RMA Flux A, increasing the solder temperature caused a significant increase in the wetting

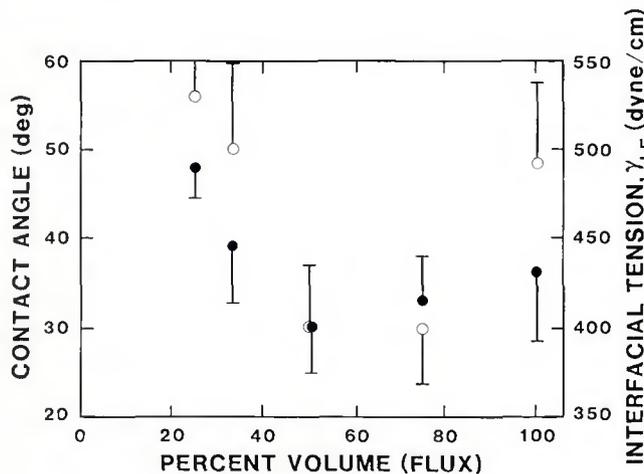


Fig. 11—Dependence of  $\theta_C$  and  $\gamma_{LF}$  on the strength of Flux D dilution on the chemically etched, plain Kovar (260°). Solid circles are the  $\theta_C$  data and the open circles are the  $\gamma_{LF}$  data.









