VLBA ACQUISITION MEMO #246

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To: VLBA Data Acquisition Group

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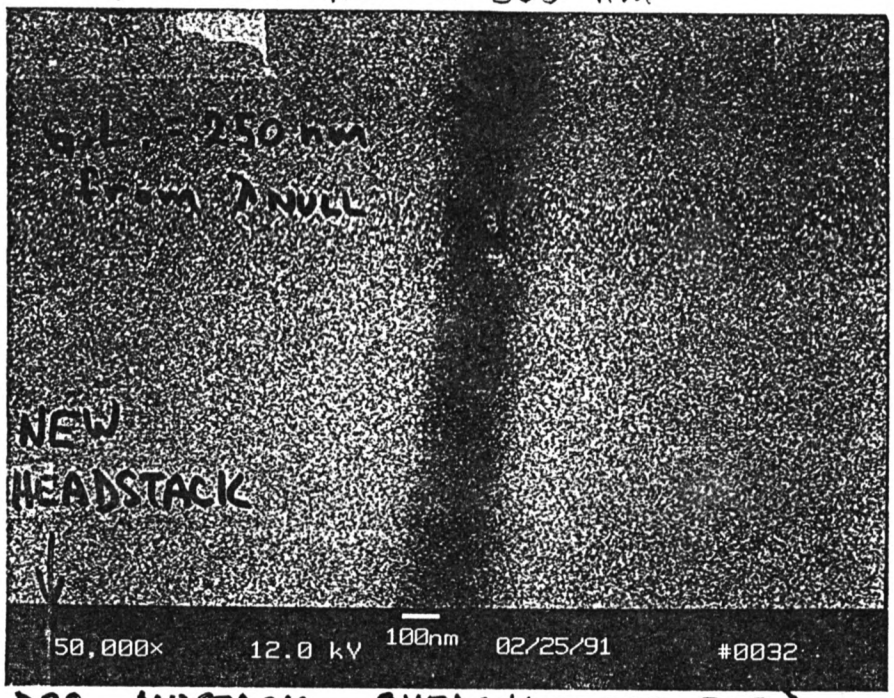
Subject: Scanning Electron Microscope (SEM) Gap Length Measurement

A Scanning Electron Microscope (Amray 1830) at Lincoln Laboratory was used to measure the "apparent" gap lengths of some gapped bars and finished headstacks. Preliminary measurements were made with gap bars and headstacks "as is", that is, without etching or sputtering on a thin conductive layer. The preliminary images were similar to that of D82 shown, where the gap edges appear fuzzy. A second set of measurements (the D82 and B27 images for example) attempted unsuccessfully to sharpen the appearance of gap edges by etching the SiO_2 gap with buffered HF for 10 seconds and sputtering 200 nm of gold onto the samples. The final image shown (#1 gap, above rear window) is sharper as a result of more prolonged etching (2 minutes) aimed at removing 200 nm of SiO_2. The significance of the highlighted edges is unclear and is possibly a ferrite smear into the gap region (as a result of lapping?). This ambiguity might be removed and the apparent sharpness of gap edges further improved by lightly etching the ferrite with HCl.

SEM apparent gap length and capacitive gap length measurements (Dan Smythe's VLBA Memo #243) agree to within present measurement errors. The capacitive gap length is easiest to measure. Its accuracy can be improved by making direct optical measurements of gap area and may be limited only by inaccuracy or variations in the dielectric constant of the sputtered SiO_2 gap.

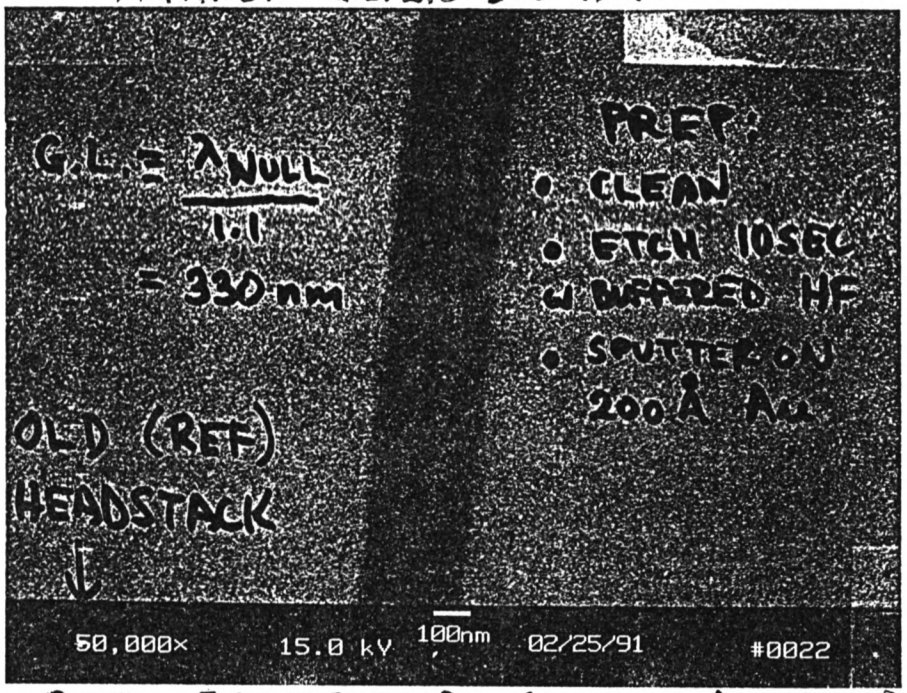
The difference in SEM apparent gap length between the old (reference) and new headstack is 70 to 100 nm, in good agreement with the 80 nm difference in magnetic gap length determined from gap null measurements. Both SEM apparent and capacitive gap lengths appear to be ~50nm shorter than magnetic gap lengths.

APPARENT G.L. ~200 nm



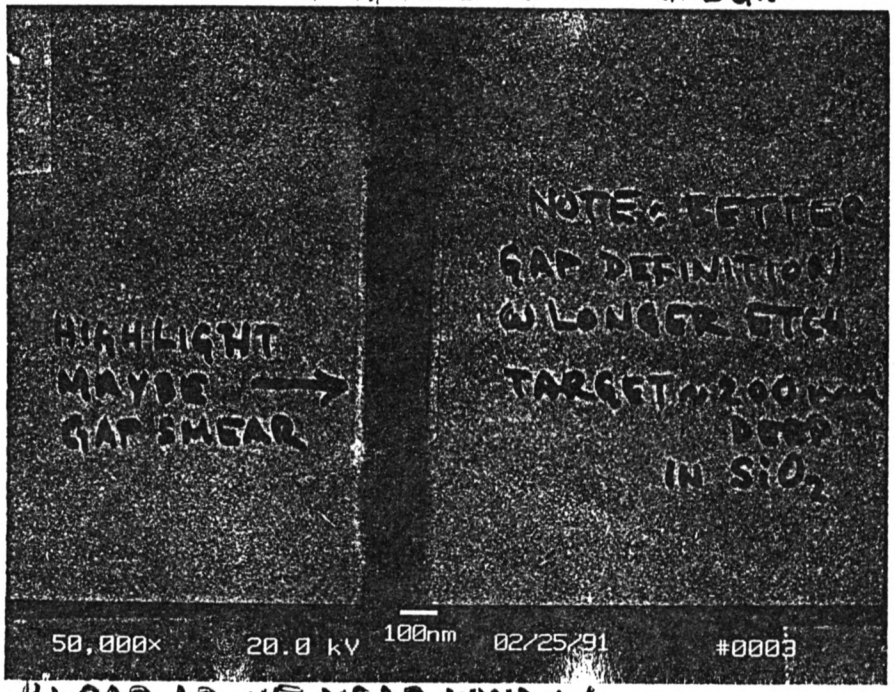
D82 MIDSTACK (HITACHI -002 BAR)

APPARENT G.L. 270-300 nm

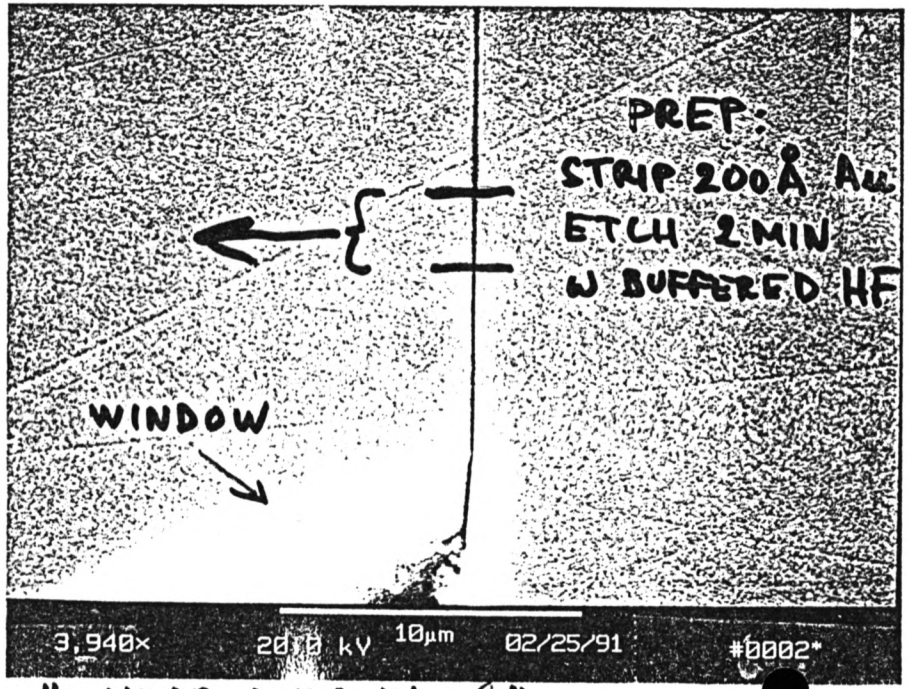


B27 FRONT END (HITACHI '87 BAR)

DARK ONLY 170→230 INCL. 'HIGHLIGHT'



#1 GAP ABOVE NEAR WINDOW



#1 NEAR WINDOW (#1 = UNCUT -0[redacted] BAR)