AbstractID: 3452 Title: Calibration of TLD Chips to Maximize Accuracy in Radiographic Phantom Dosimetry

Purpose: To develop an efficient annealing/readout protocol for TLD dosimetry that will maximize the accuracy and precision in radiographic dosimetry measurements.

Method and Materials: 500 TLD chips were grouped in batches of 100 and subjected to varying annealing protocols and then irradiated to varying exposure levels. Three different annealing/readout protocols were tested. In protocol #1, the chips were annealed at 400 C for 1 hour followed by 2 hours at 100 C. The chips were exposed, and then allowed to rest for 24 hours before reading. In protocol #2, the anneal cycle was 400 C for 1 hour followed with a 30 minute cool-down, followed by 20 hours at 80 C. Immediately after exposure, the TLD's were heated to 120 C for 10 minutes, then read. In protocol #3, the anneal cycle was 400 C for 1 hour followed by a 30 minute cool-down, then 100 C for 2 hours. After exposure, the TLDs were pre-heated and read as in protocol #2.

Results: For protocol #1, the inter-exposure uncertainty in the response (nC/mR) was approximately 4.2%. Using protocol #2, the intra-batch uncertainty was reduced to 4.0%, and for protocol #3 the uncertainty was reduced to ~3.7%. By using individual chip calibrations, the intra-batch uncertainty for estimating consecutive exposures was reduced to 3.5%, 1.8%, and 1.7% for protocols #1, 2, and 3, respectively. By binning TLD signals over groups of 3 chips, the uncertainty in estimating exposures was reduced to ~1.1% for protocol #3.

Conclusion: With careful calibration and binning of results, an accuracy approaching 1% is readily obtained. The anneal/readout protocol that yielded the highest accuracy also required the least time for a complete cycle, with a batch of 100 chips being processed in <1 working day using a single furnace for annealing and a single-chip reader.