The Effect of Three and Four Point Uniaxial Bend Tests on Germanium Wafer Break Strength Data Variability

Mathews, Logan

Germanium wafers are primarily used in multijunction photovoltaic cells for aerospace applications. Due to the expense of Germanium, wafers are very thin, and thus very susceptible to fracture and damage. Load parameters must be established to ensure the operational limits of the wafers, so that end products can be used reliably without damage due to loading. Load testing Germanium wafers is also essential to provide quality control and improving manufacturing processes. Currently point-on-ring tests are being used, and produces unreliable and highly variable data. Research was conducted, and a three-point bend test had earlier been shown to yield promising reductions in variability. Further research constituted that a four-point bend test may improve upon three-point testing. Three and four-point bend tests were hypothesized to reduce data variability when testing break strength. Two new fixtures were then engineered, machined, installed, and tested. ~25 wafers of type 175c, and 175u were used to test the fixtures. Data was recorded and analyzed statistically using a two sample F-test. It was found that both new testing methods provided a statistically significant (<.05) reduction in data variability across all three wafer types. As hypothesized, testing concluded that by implementing three or four-point bend tests over a point-on-ring test method, more reliable and less variable data can be produced, allowing for more accurate measurements and greater precision.