

Quantifying the Mechanical Breakdown of E-waste in Laptops

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Research Question

Can we quantify the breakdown of electronic components in products and measure the release rate of fragmented e-waste components?

Background:

Electronic waste breaks into particles through mechanical abrasion and can contain heavy metals, which are toxic to biological systems and can be transported via polymer particles.

Materials

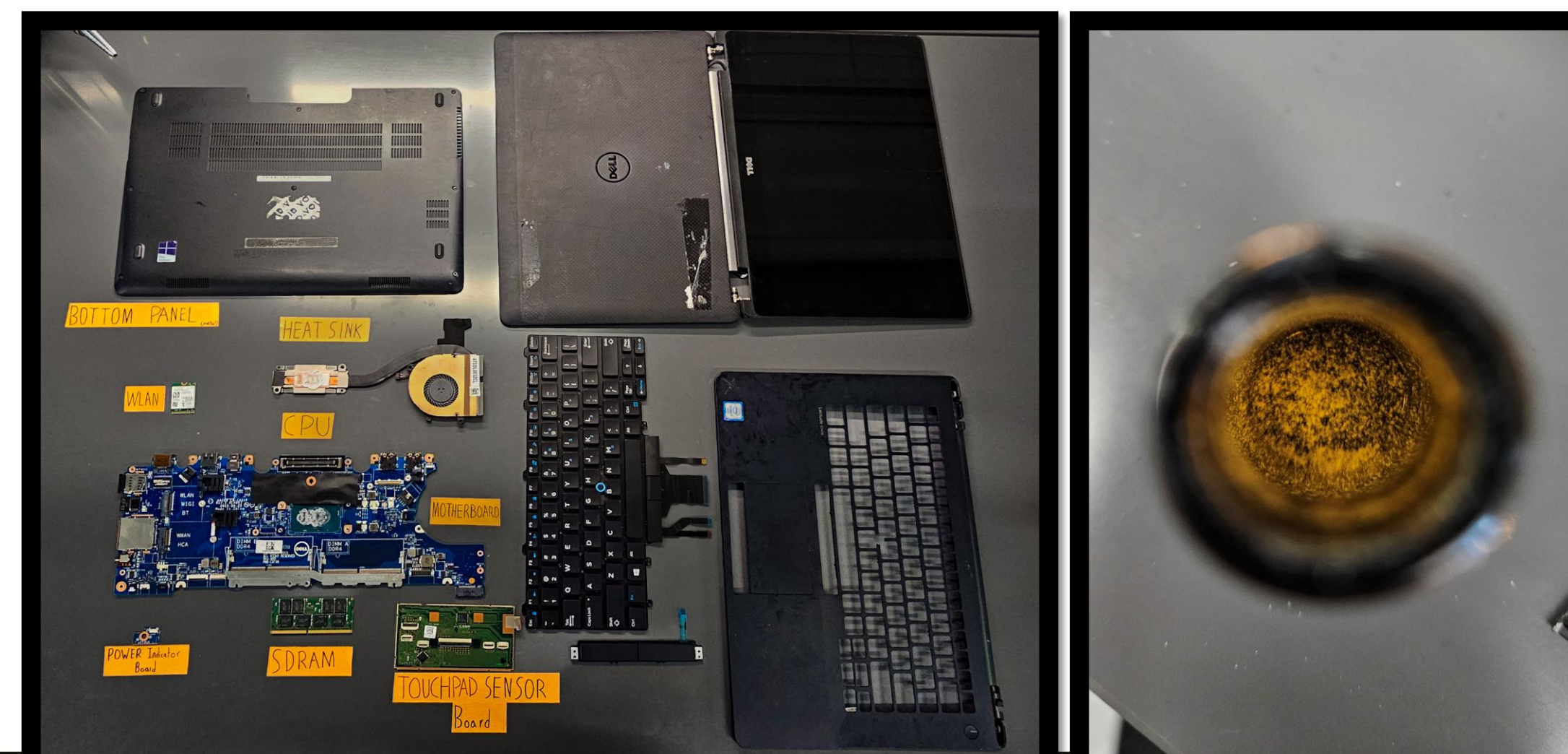
Dell laptops were selected for analysis from AZStrut as personal electronics are most mismanaged waste and have high refresh rates from consumers.

All components were disassembled (see Figure 1 and 2) to analyze each component within the laptop assuming they are separated during the mismanagement of waste in landfills and the environment.



Figure 1 (left) – Image of an SDRAM card

Figure 2 (right) – Image of disassembled laptop components



Method

Surface roughness and mass measurements were taken before material breakdown with the highest roughness value. FTIR and SEM would be used to analyze the abraded particles for material characterization.

The method of breakdown selected was via mechanical abrasion, using a NIST-standardized machine from Dr. Sipe's lab to correlate fragmentation to force applied.

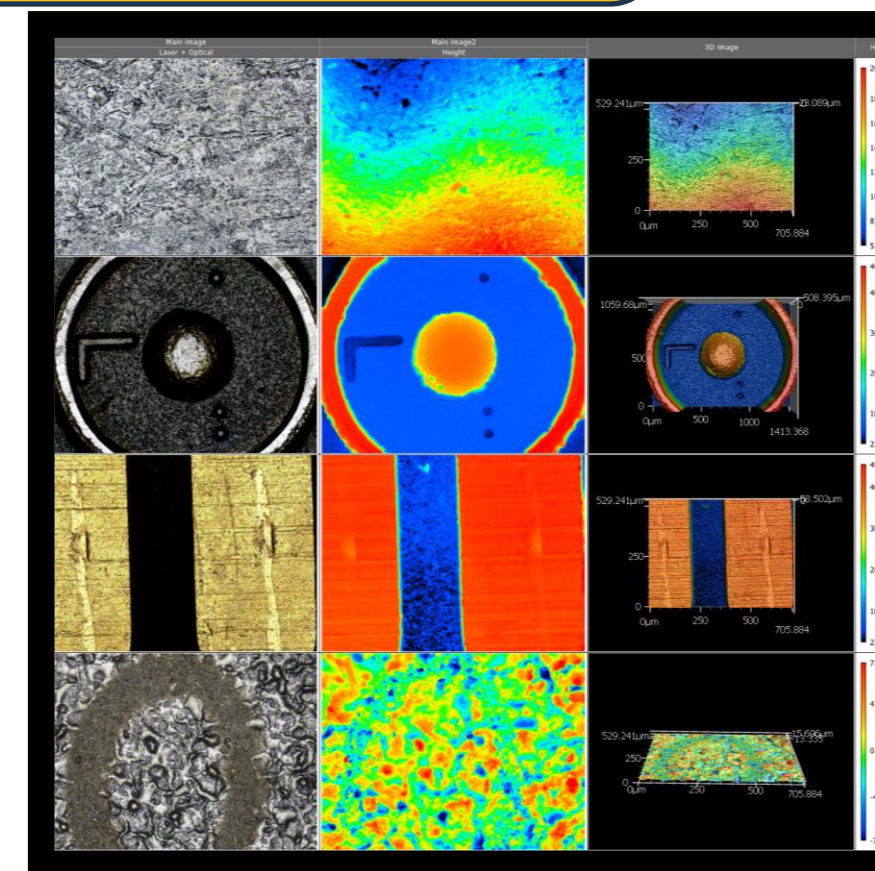


Figure 3 – Surface roughness of various parts

3a – Ribbon cable clamp

3b – WLAN port

3c – WLAN gold teeth

3d – Memory IC EMC

Figure 4 (below) – Top view of collected particles in bottle

Sample Analysis Comparisons

Out of the surface roughness values taken, the three highest values came from the Touchpad Board microcontrollers, the SDRAM memory ICs and the touchpad itself.

The touchpad was selected for abrasion, with an overall mass loss of 0.0769 g, with a linear fit of 0.002 g/m² s for fragmentation analysis.

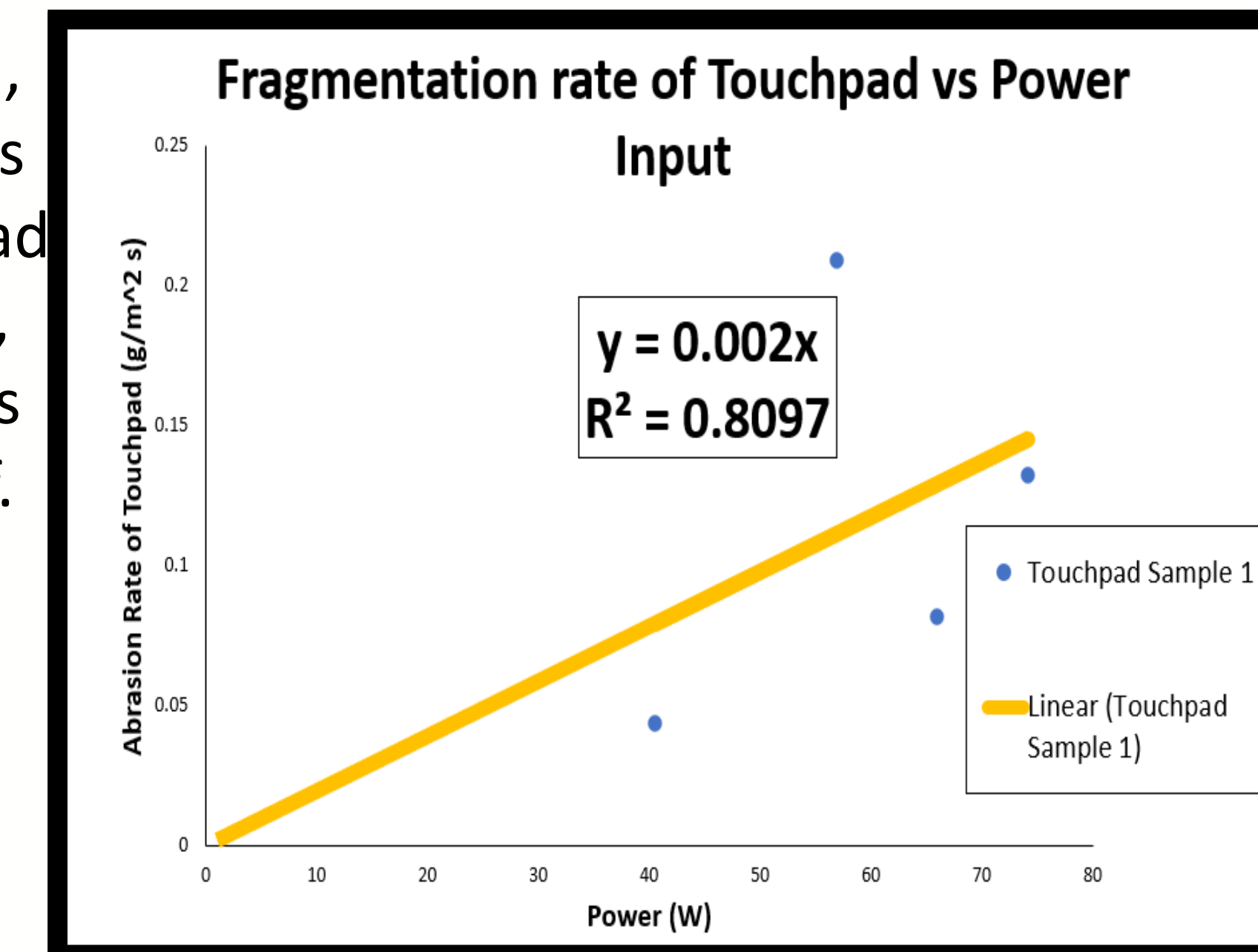


Figure 5 – Graph of abrasion testing of touchpad to varied power inputs

Conclusions and Future Work

Future work, now with a framework, should continue analysis via FTIR and respective abrasion graph rates on each component.

Special Thanks to AZStrut and Camilla Roberts to providing computers to test this e-waste project. Dr. Tyrone Benson for his guidance on selecting the e-waste devices and connection to AZStrut. Gigi Jackson for training and support on profilometry.