Introduction
Stretchable electronics is a new field aiming to enable a range of bio-compatible futuristic devices (Fig. 1,2). Interface delamination is a precursor to the failure of stretchable electronics made of elastically mismatched metal interconnects and rubber matrix materials.

Goal
Characterize interface delamination of the copper rubber interface.

Methods
Analysis of real-time in-situ ESEM imaging of the progressing delamination front of peel test experiments using three different rubber materials (PDMS, TPU180 and TPU200) (Fig. 3,4,5).

Micro scale delamination mechanics
Investigating the peeled surface shows that, samples that have the highest Work of Separation (WoS) do not have the cleanest surface. This means that the increase in WoS can not entirely be accounted as increased interface integrity (Fig. 5). During delamination there is a delicate balance between the forming, elongation and rupture of fibrils and interface debonding.

Conclusions
- The peel test produces reproducible data which can be simulated using Cohesive Zone models.
- Fibrilation of the rubber is observed, where 50μm long fibrils are formed.
- A delicate balance arises between the rupture of the fibrils and delamination of the interface.
- The rubber fraction on the delaminated Cu surface decreases with increasing rubber toughness and/or decreasing interface adhesion.

Figure 1: Intraocular retinal sensor array. Figure 2: Neural activity monitoring array.

(a) TPU 200°, Ar = 5.9%, Gc = 3.7kJ
(b) TPU 180°, Ar = 12%, Gc = 2.9kJ
(c) PDMS, Ar = 87%, Gc = 1.3kJ

Figure 3: Schematic of the peel test. Figure 4: µ-tensile stage situated in the ESEM.

Figure 5: ESEM images of the rubber fraction Ar left behind on the copper surface after peeling (left), rubber is shown in black and copper in yellow, Gc is the work of separation. Additionally fibrillation of the progressing delamination front is visualized (right).