# Diffusion of Co and W in diamond tool induced by 10.6 µm $CO_2$ laser radiation

**BN Masina[1], A Forbes[1], BW Mwakikunga[1], and R Bodkin[2]**

**[1]CSIR National Laser Centre, PO BOX 395, Pretoria 0001, South Africa**

**[2]Element Six (Production) (Pty) Ltd, 1 Debid Rd, Nuffield Springs 1159, South Africa**

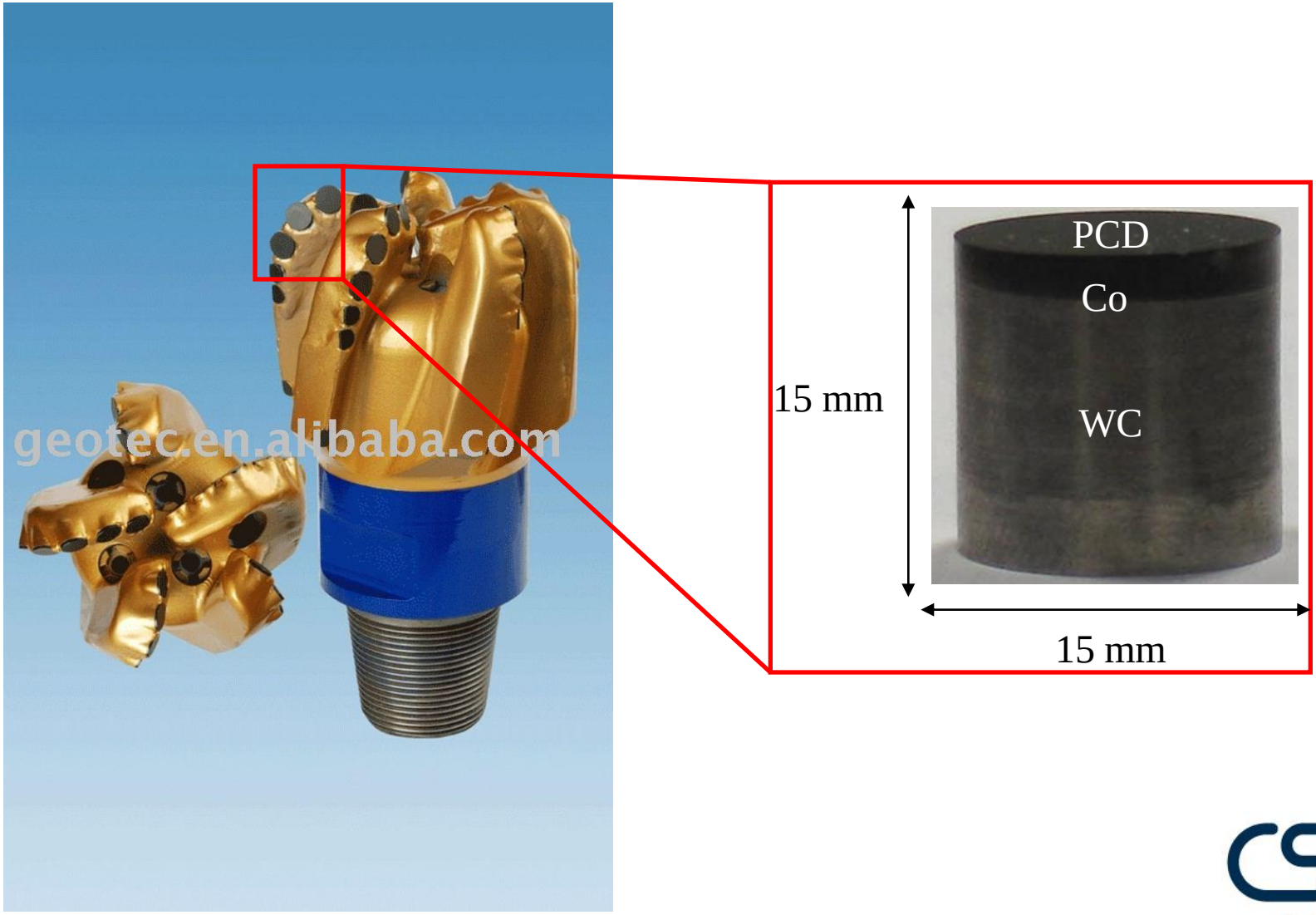
**SACPM 2011 Conference**

**2 – 6 May 2011**

our future through science

# Diamond tools for oil and gas drilling

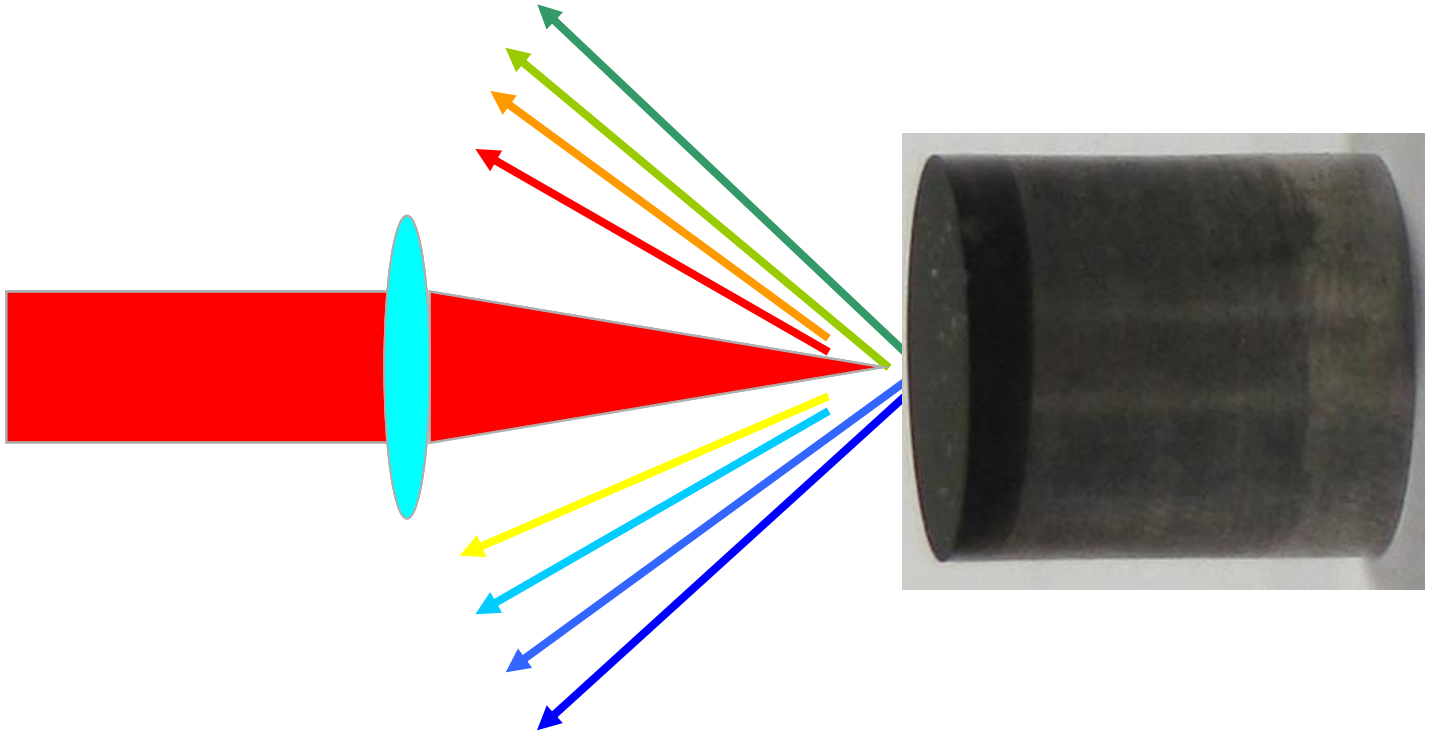
# Typical drilling tools



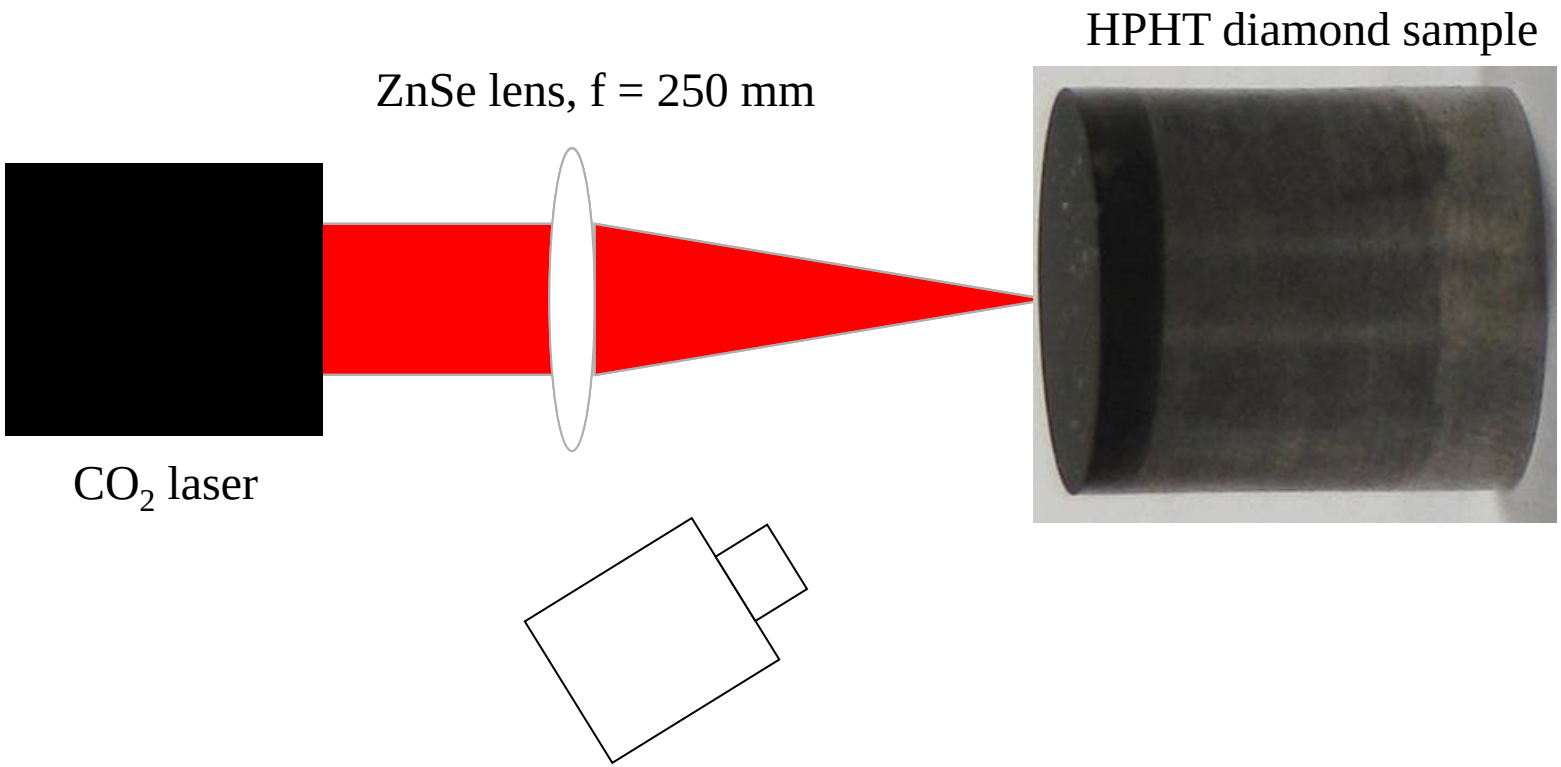
# At present it is known that diamond tool degrades with time as it is normally used at high temperatures

One of the question we like to answer in this study **is whether thermally induced problems in diamond tool arise as a result of the temperature value itself?**

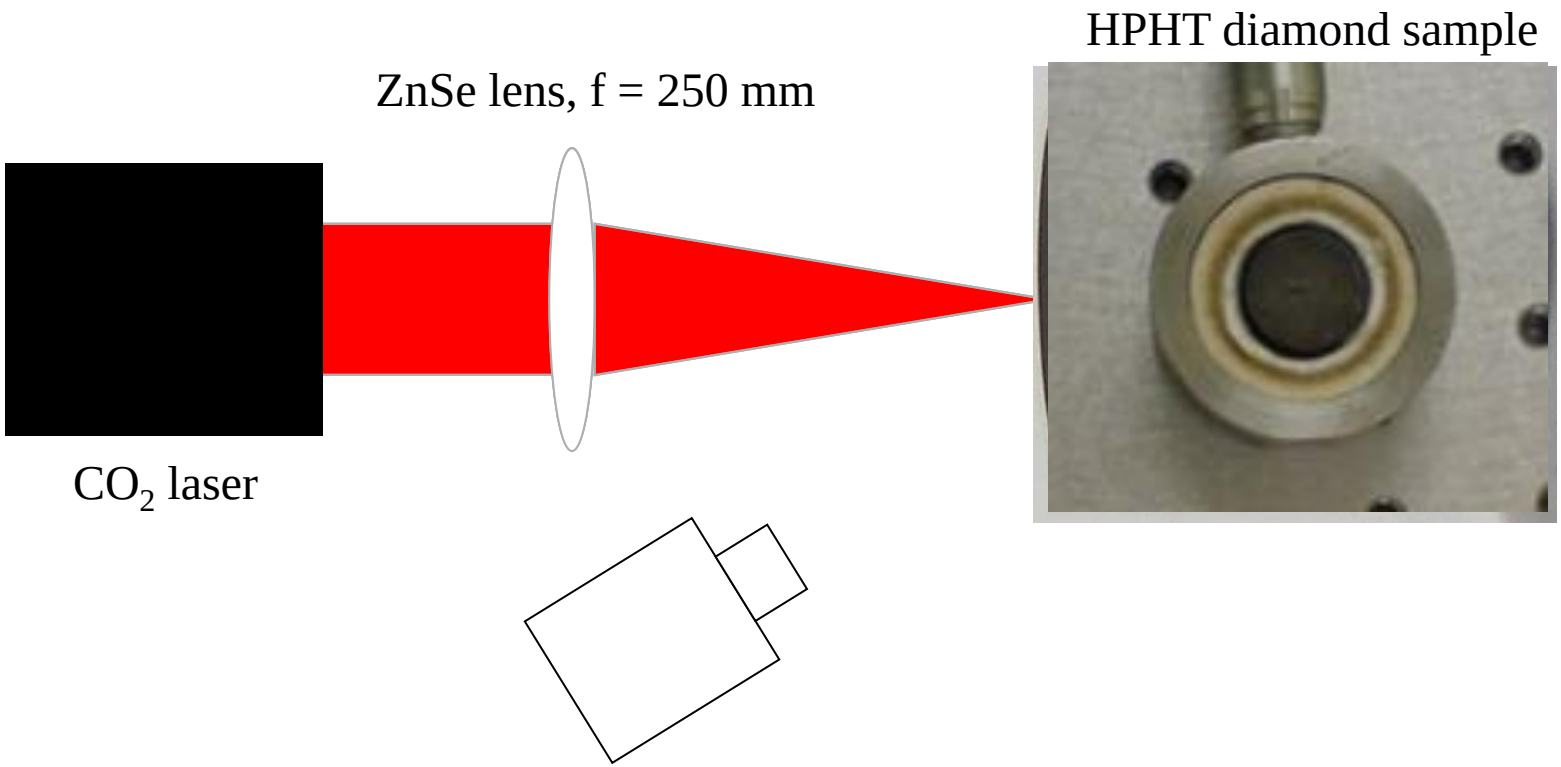
# We raised the temperature of the diamond tool sample by laser heating it



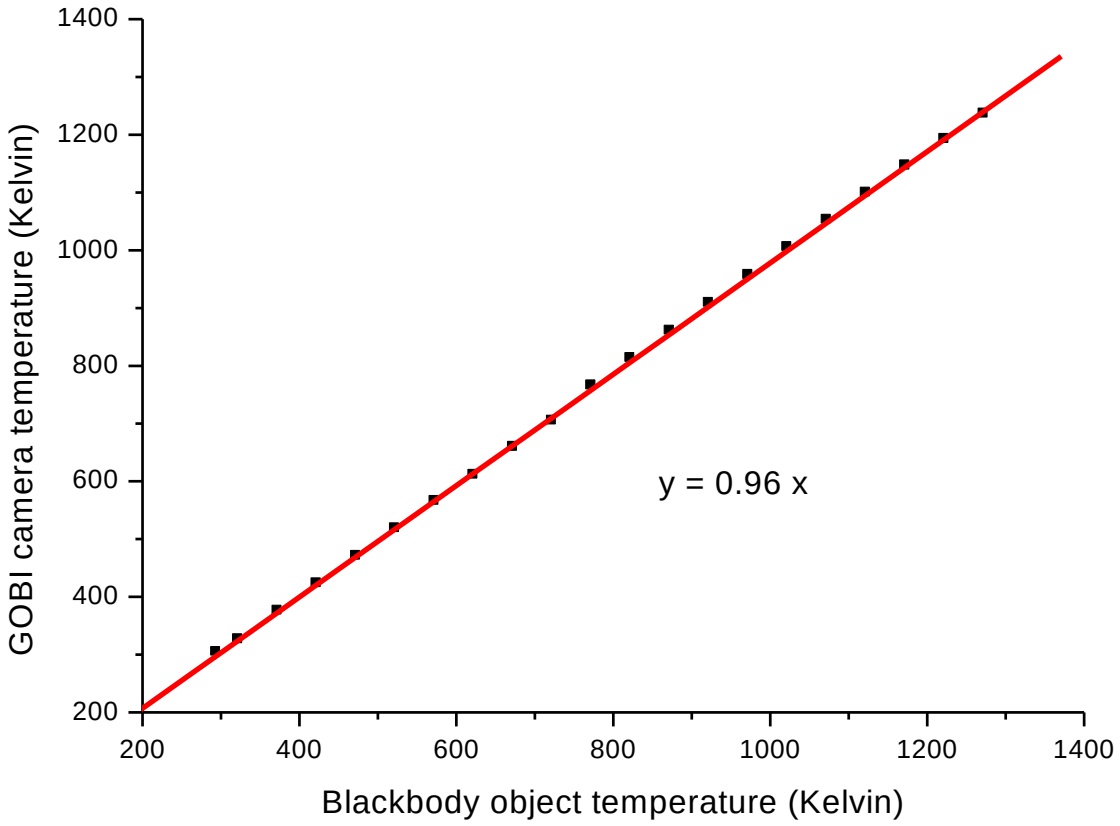
# Experimental setup



# Experimental setup

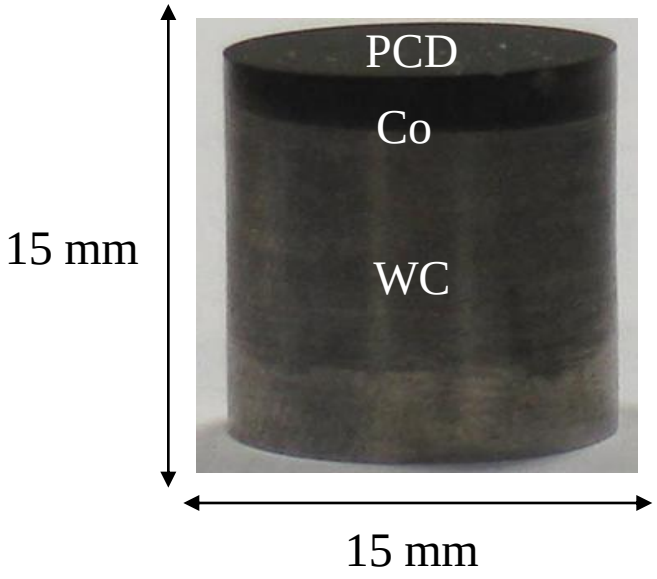


# Characterisation curve



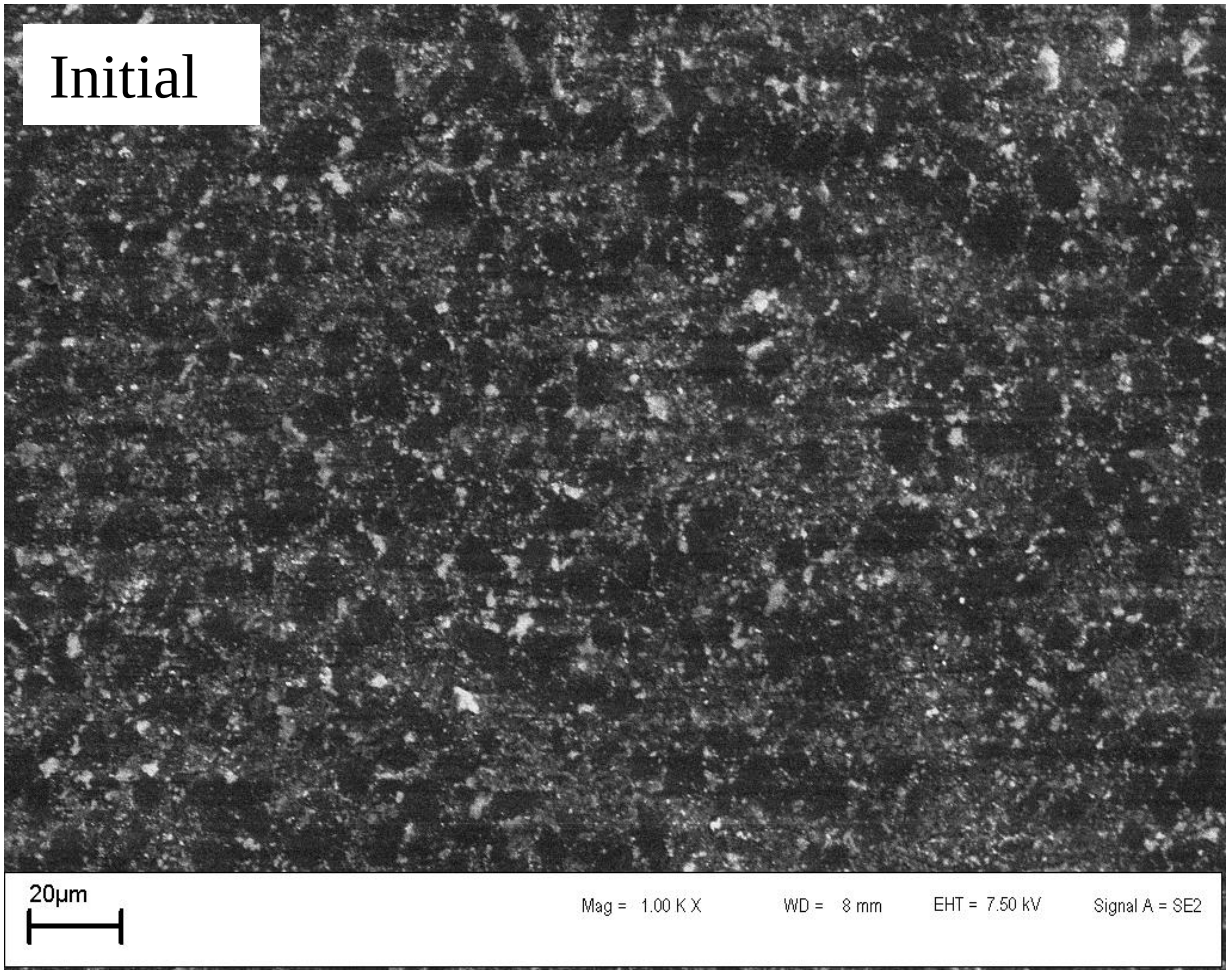
# Diamond tool samples

Initial

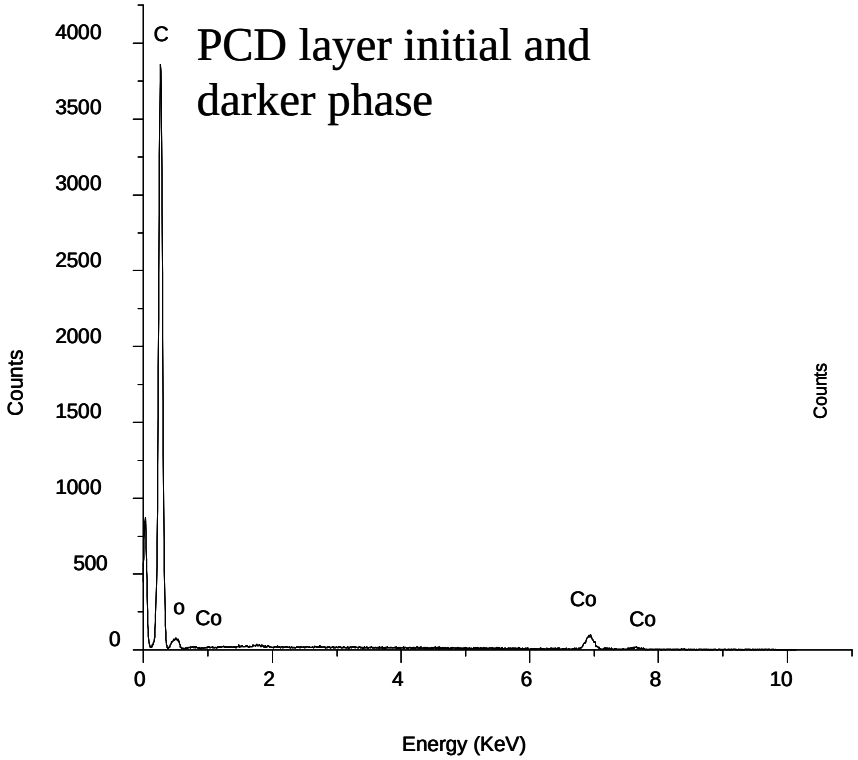


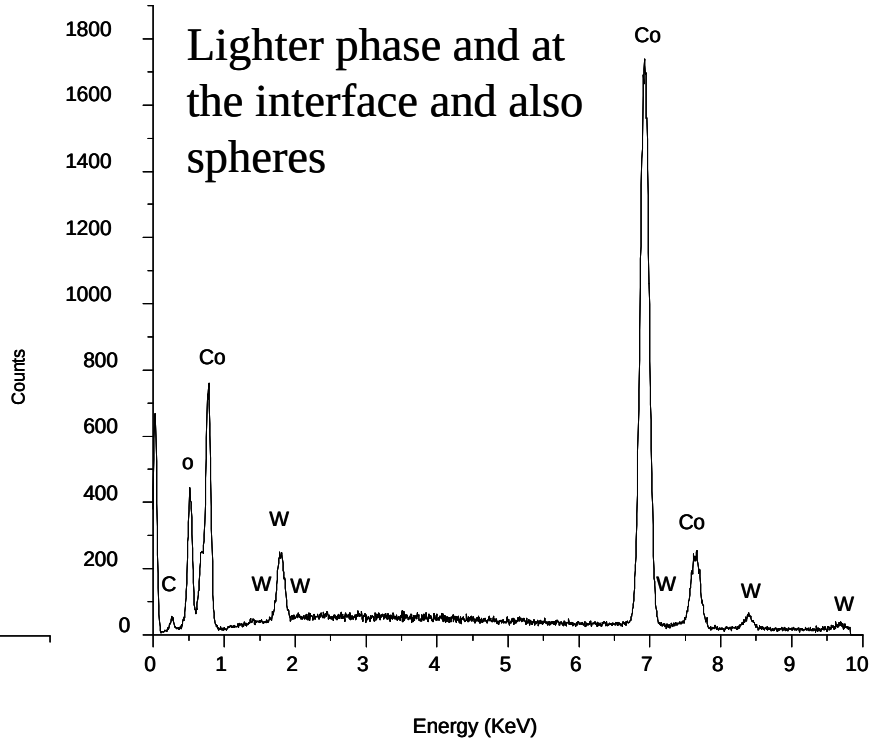

After Laser heated for 15 + 30 minutes = 45 minutes

# Initial, the PCD layer was made of C and trace amount of Co



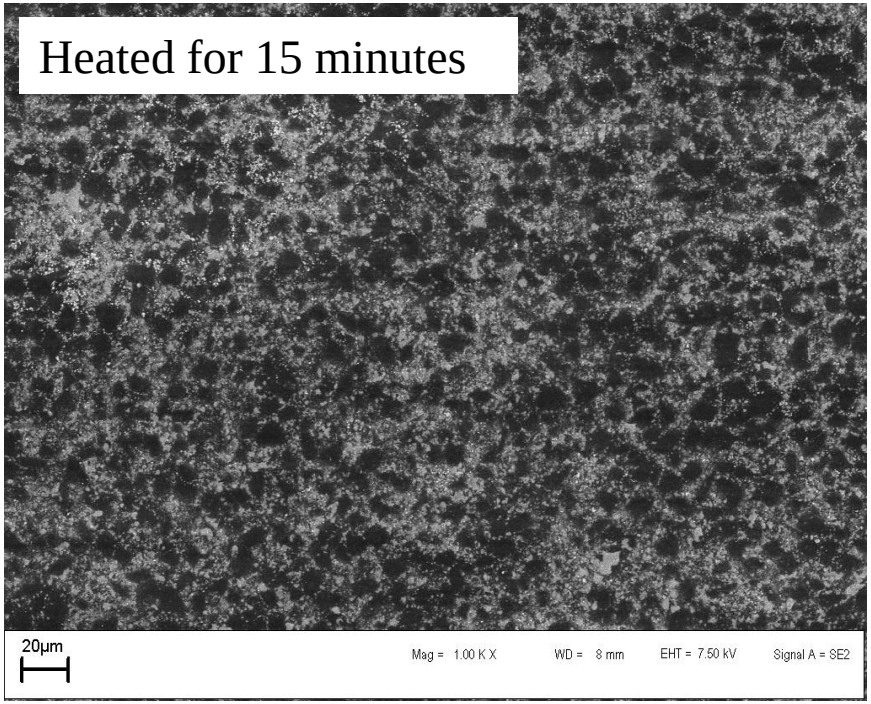
# Typical EDS spectra

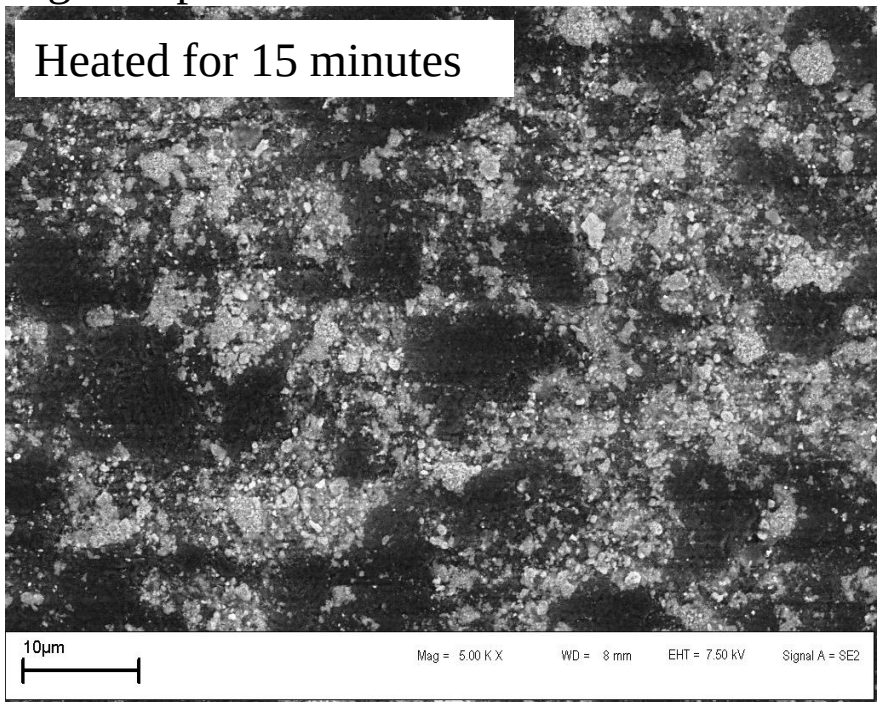


# We observed the increment of Co and W on the PCD layer

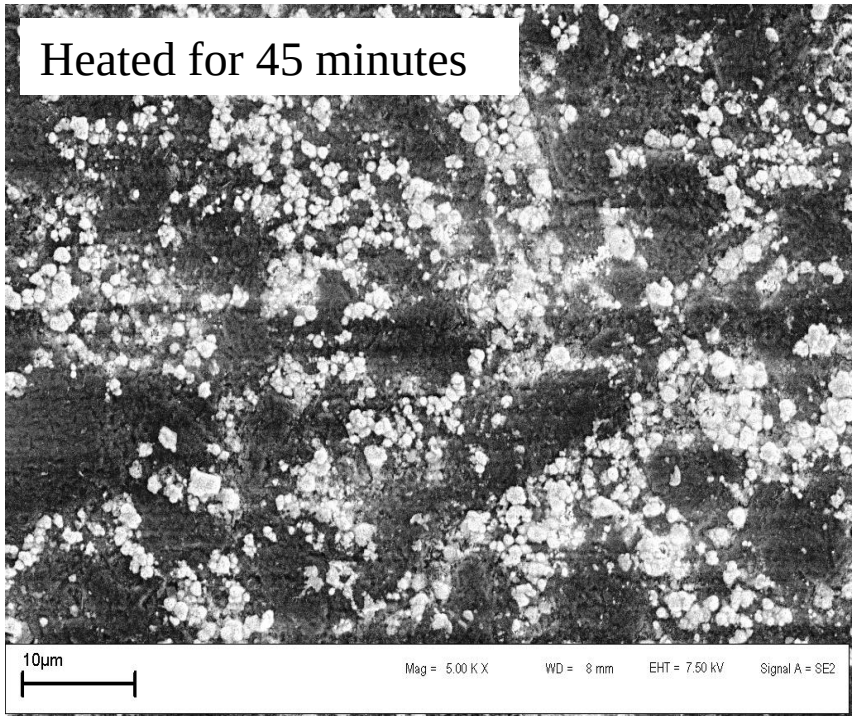
Laser heated for 15 minutes and average temperature was 658 K

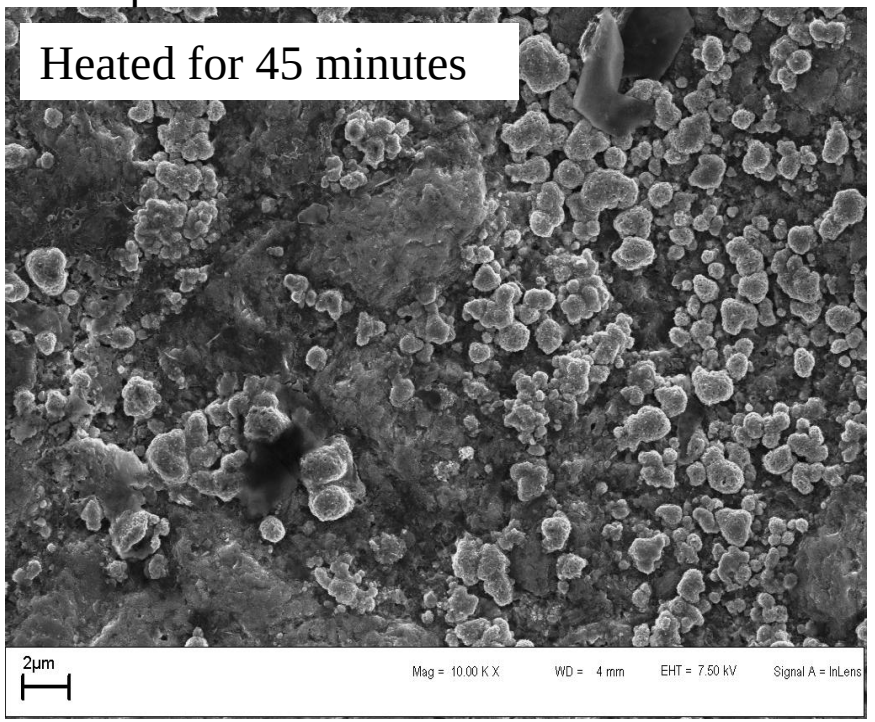


# We observed the formation of microstructure oxides at the surface of the PCD layer

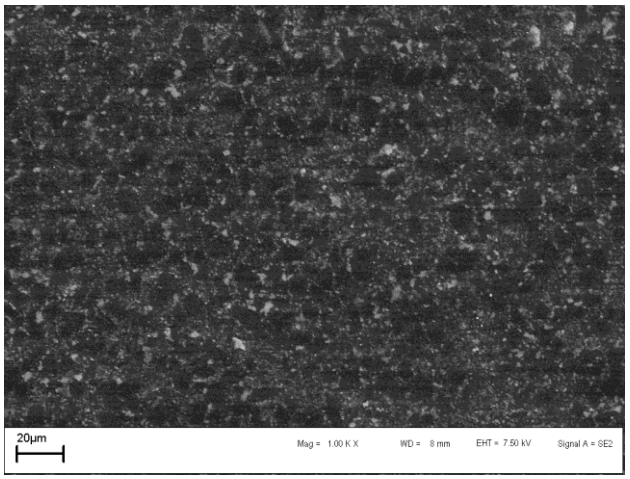
Laser heated for 45 minutes and temperature was 681 K

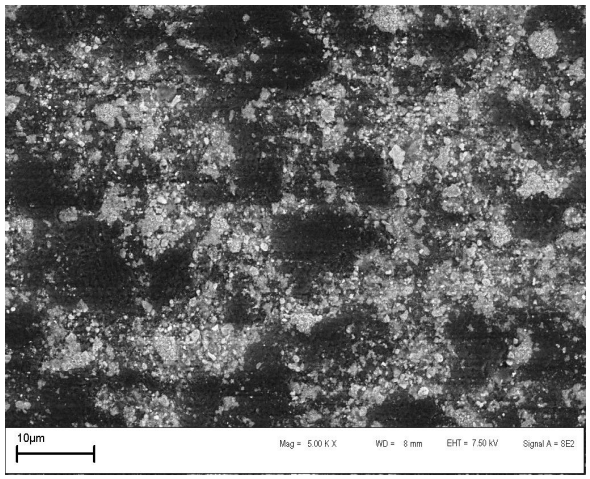


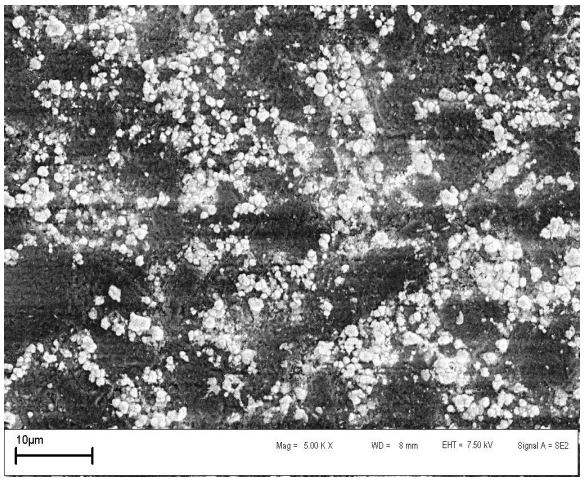



# SEM Micrographs

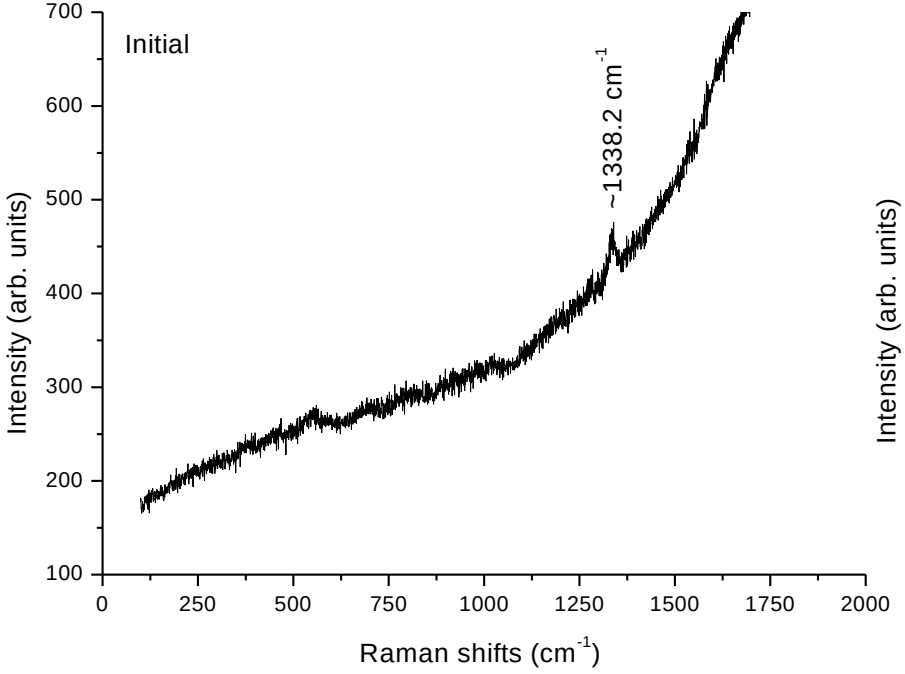
Increasing laser heating time

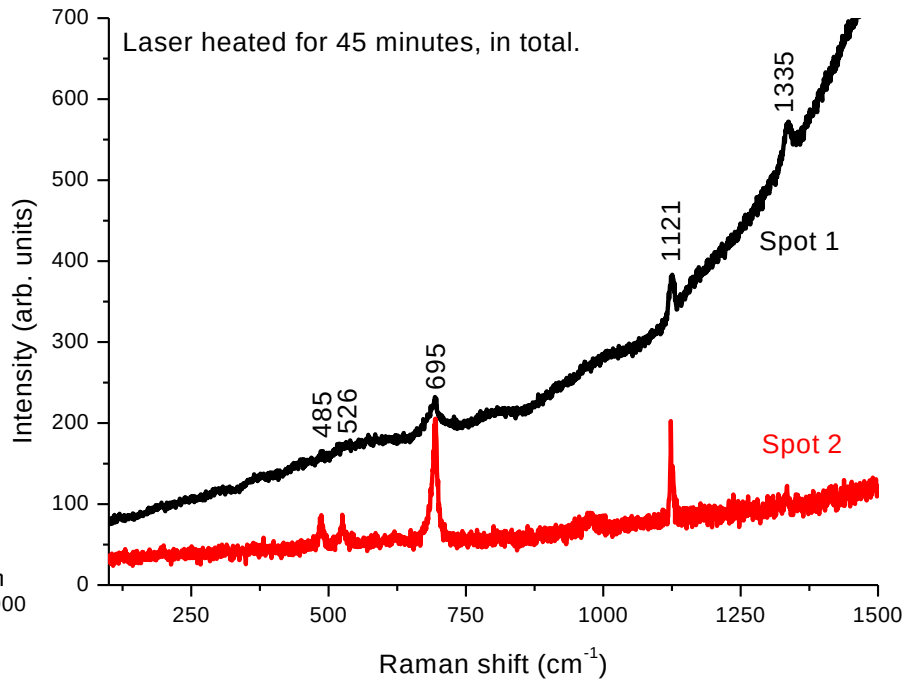


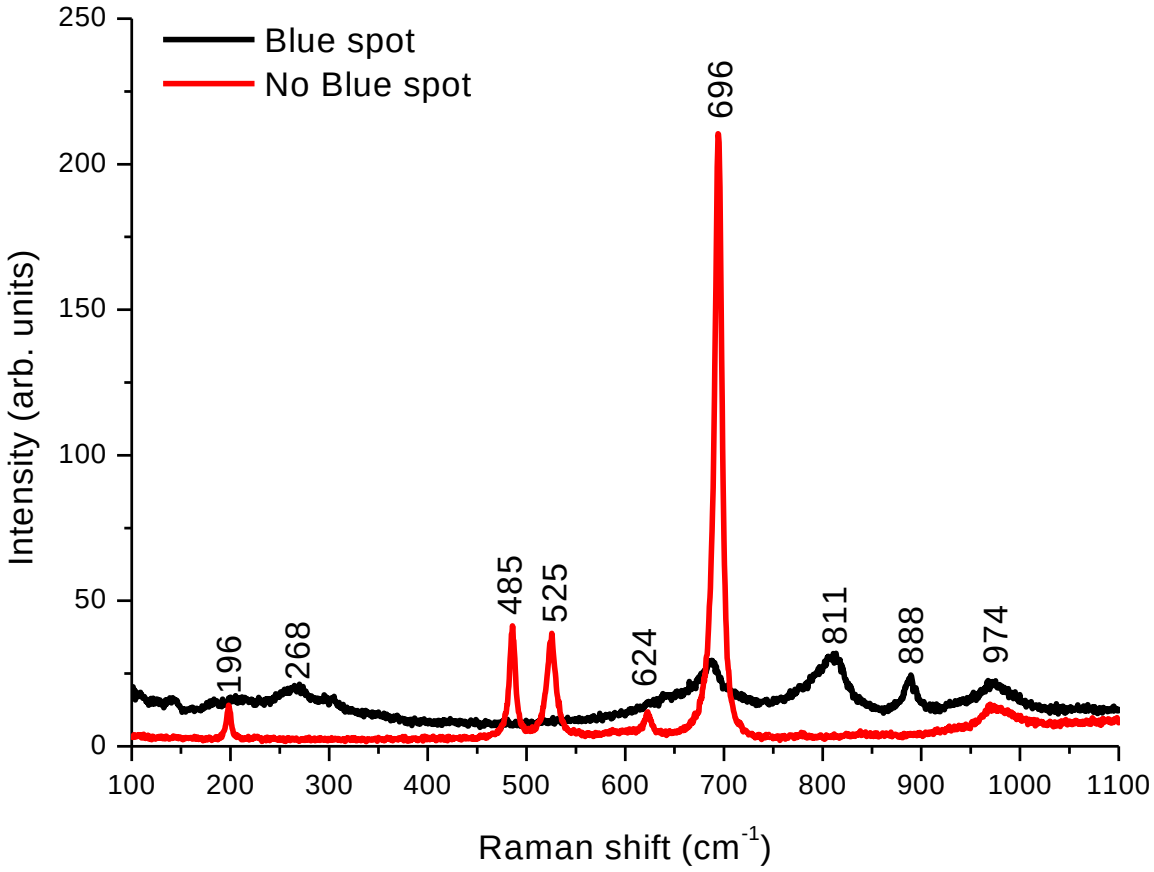



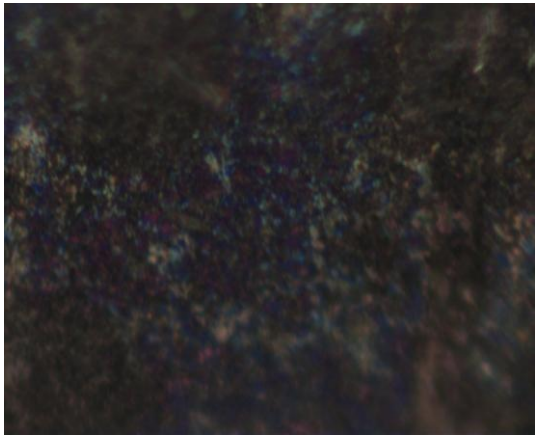
# Raman spectra

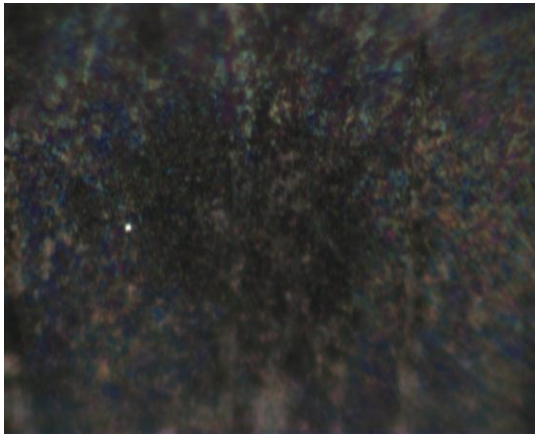


# Raman spectra





# Conclude remarks

We have successfully raised the temperature of the diamond tool sample and measure it.

We successfully observed the increment of Co and W content on the PCD layer.

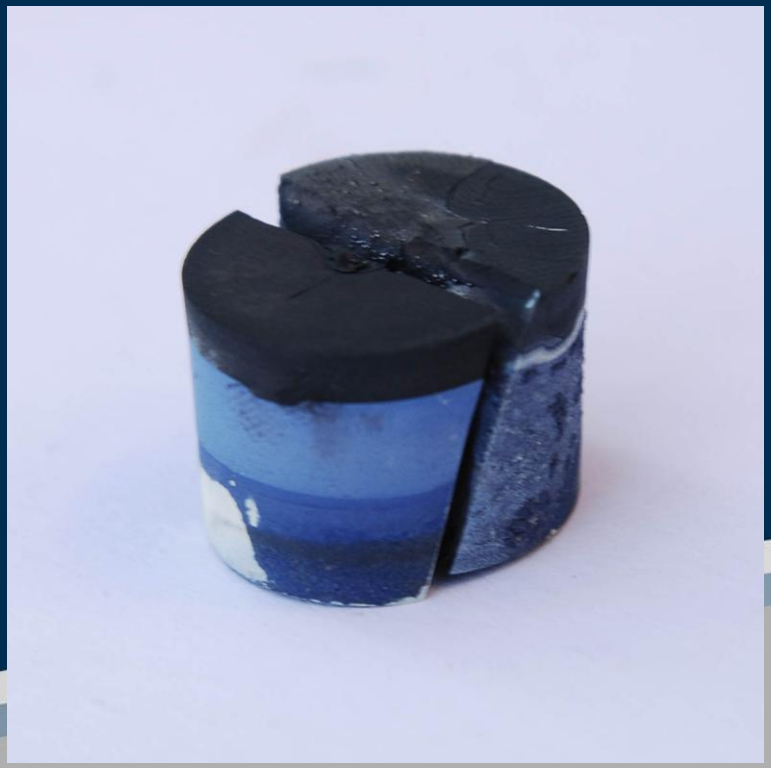
We successfully observed the formation of microstructure oxides on the PCD layer.

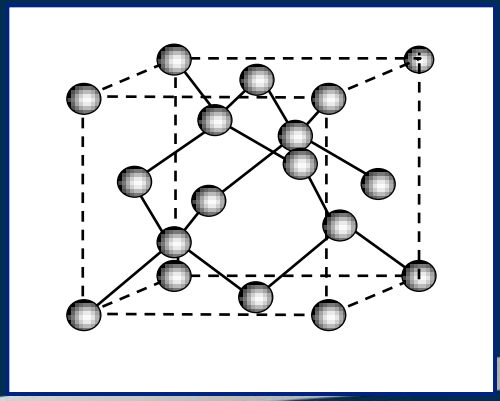
We show that the temperature in the diamond tool is sufficient to radically alter its physical and chemical properties, resulting in critical fracture.

Future work:

To determine by how much Co and W migrate on the PCD layer during the raising of the diamond tool temperature.

# Thank you





our future through science