The Analysis of WC surfaces and Diamond Thin Films by Laser-Acoustic Surface Waves

LAwave

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Presentation Outline

Diamond Coating

- Production flow
- Process and equipment
- Microstructure

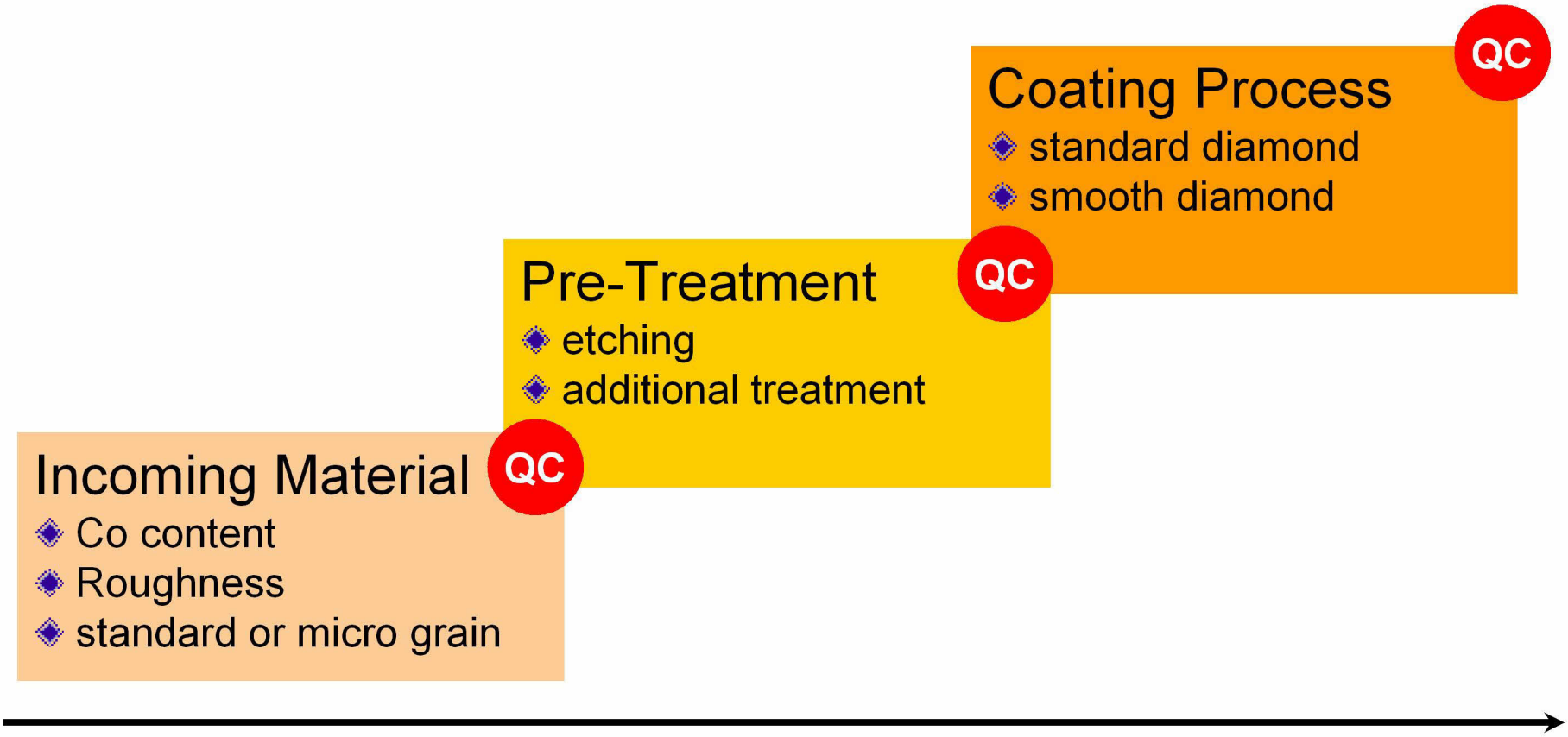
Quality control by E-Modulus

- LAWave® equipment
- Measurement quantities

Results

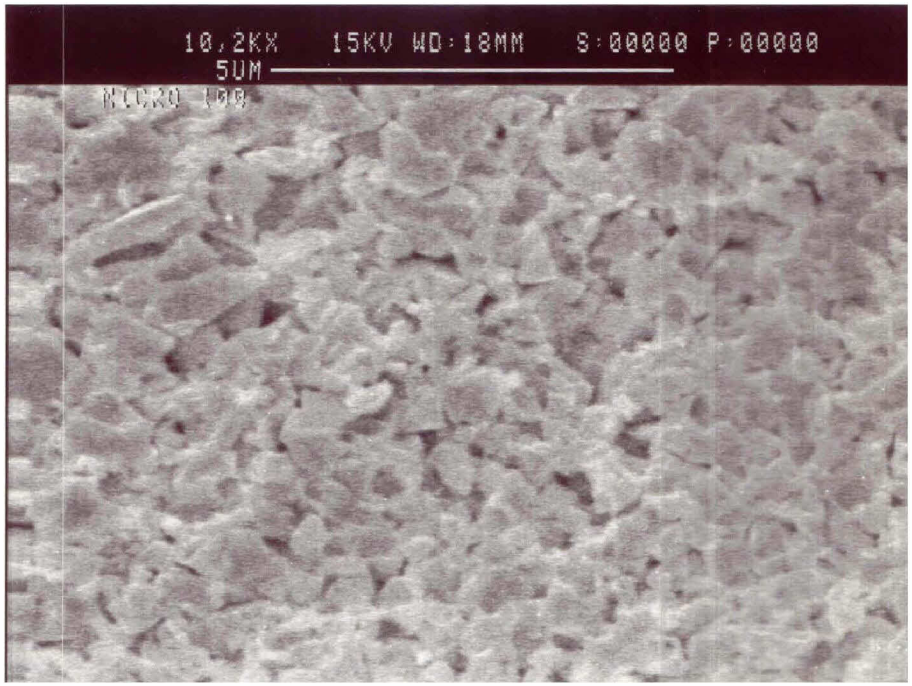
- Overview LAWave® spectra
- Ground versus ground & etched
- Diamond coatings

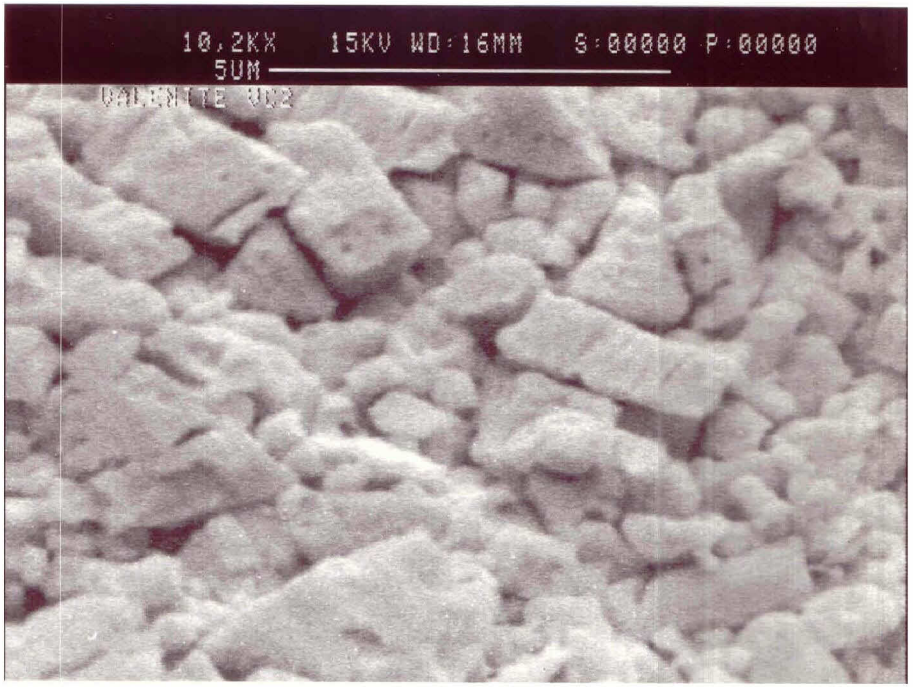
Diamond Coating – Production Flow



Diamond Coating – Equipment & Process

Diamond Coating – Micro vs. Standard Grain Substrate





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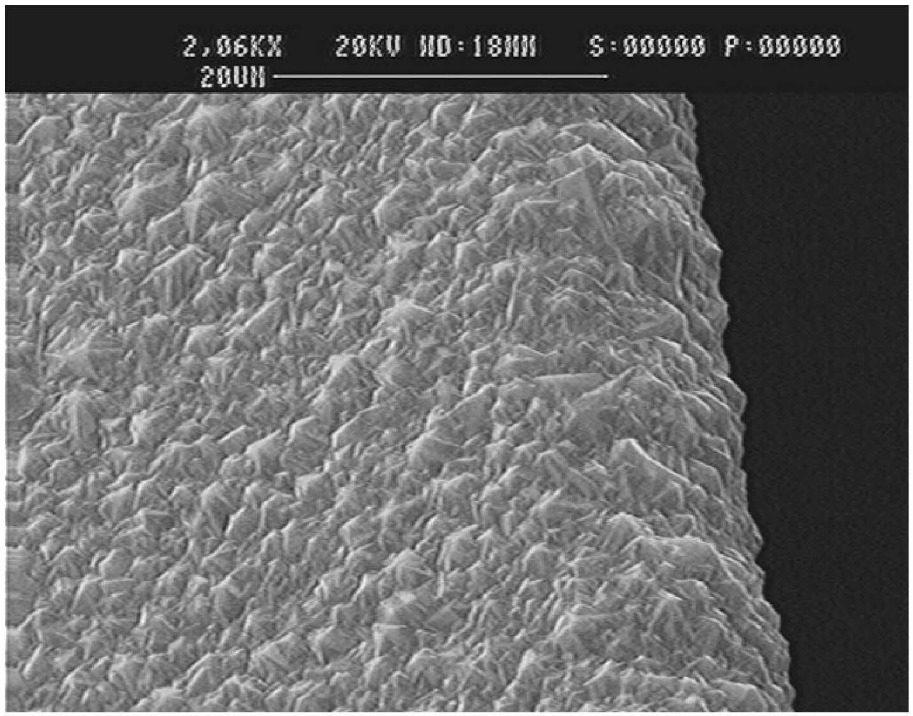
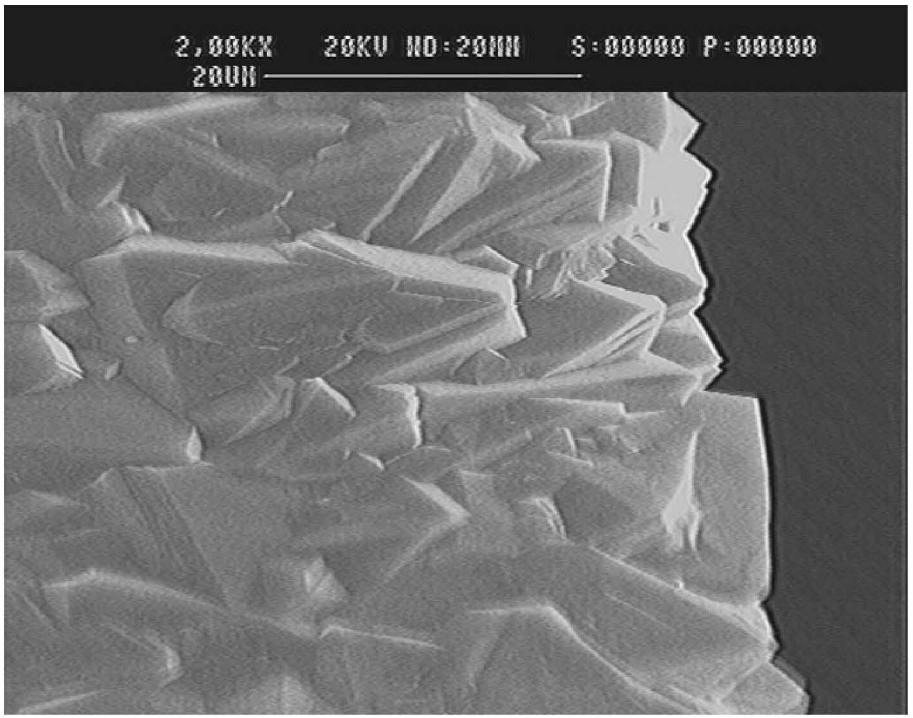
Diamond Coating – Smooth vs. Standard Grain Film





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E-Modulus as Sensitive Quantity to Control Quality

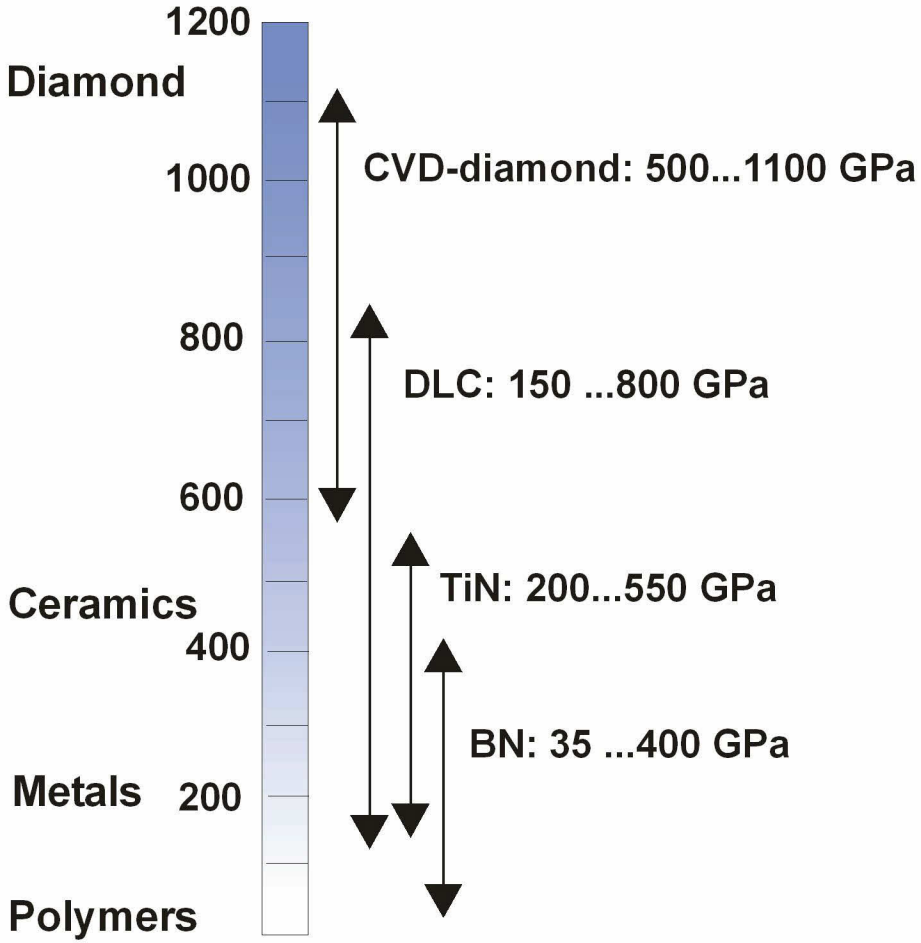
E- modulus for some bulk and coating materials

Highest modulus
diamond (E = 1147 GPa)

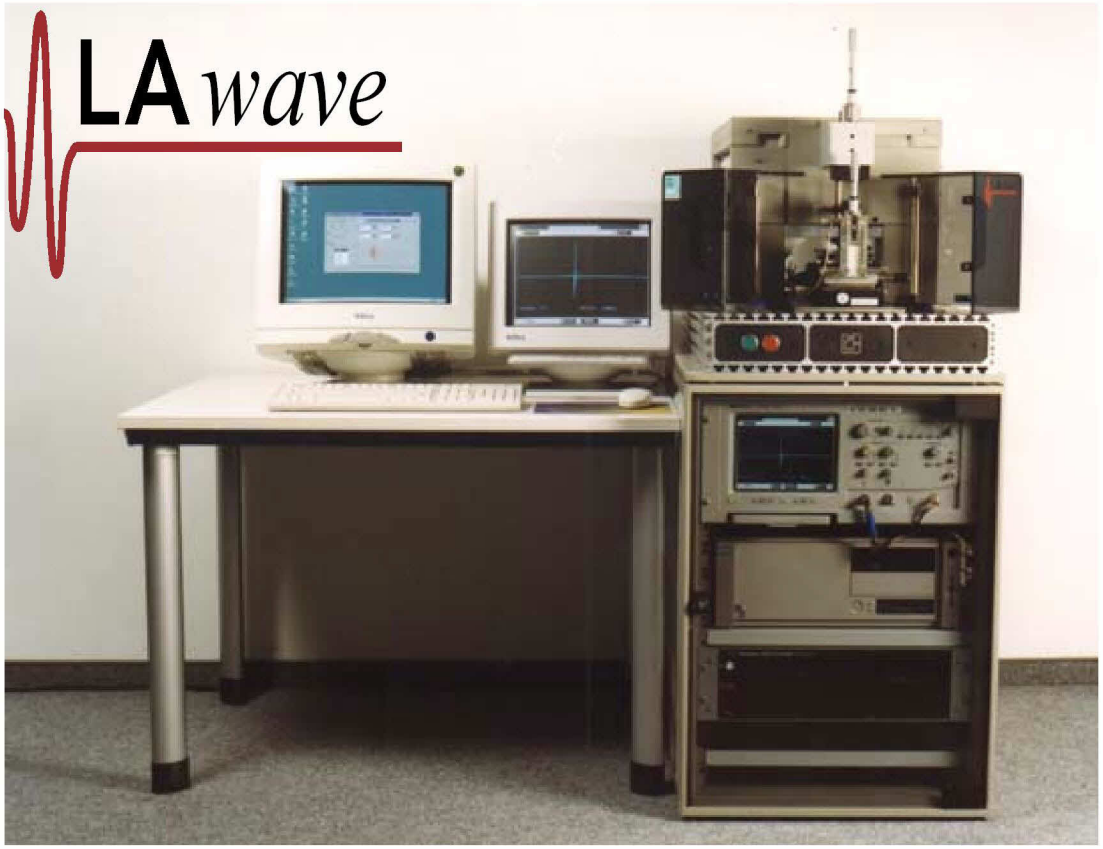
Lowest modulus
polymers

Coatings
Considerable variation depending on deposition parameters

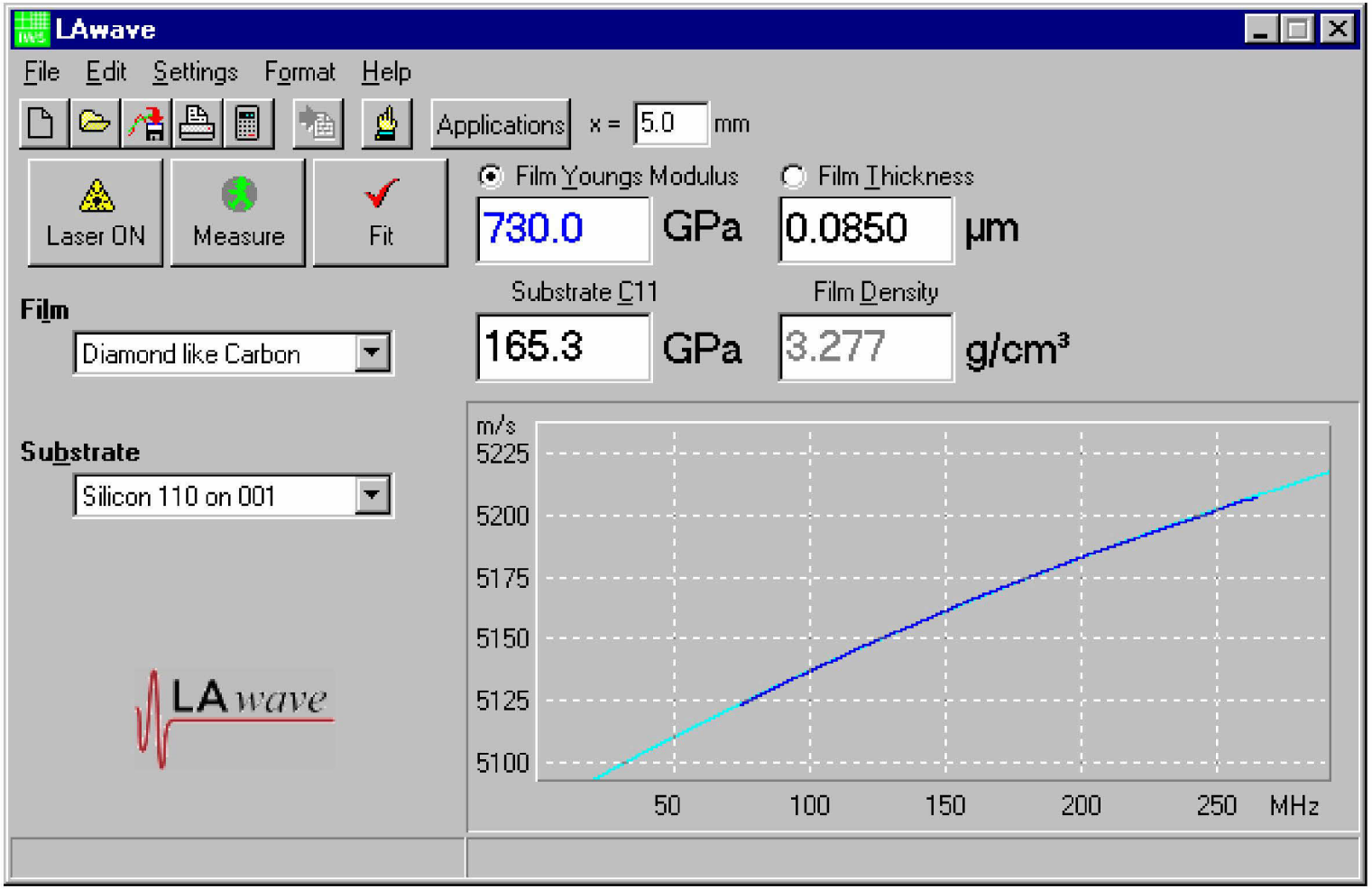
→ **Quality Control**



Laser-Acoustics LAWave – Equipment



Laser-Acoustics LAWave® – Software Interface



Laser-Acoustics LAWave® – Characteristics

- Non-destructive measurement
- Fast measurement cycle
  → < 2 min
- Accurate measurement cycle
  → $\Delta c/c = 2 \times 10^{-4}$
- Easy-to-use equipment
  → handling, software

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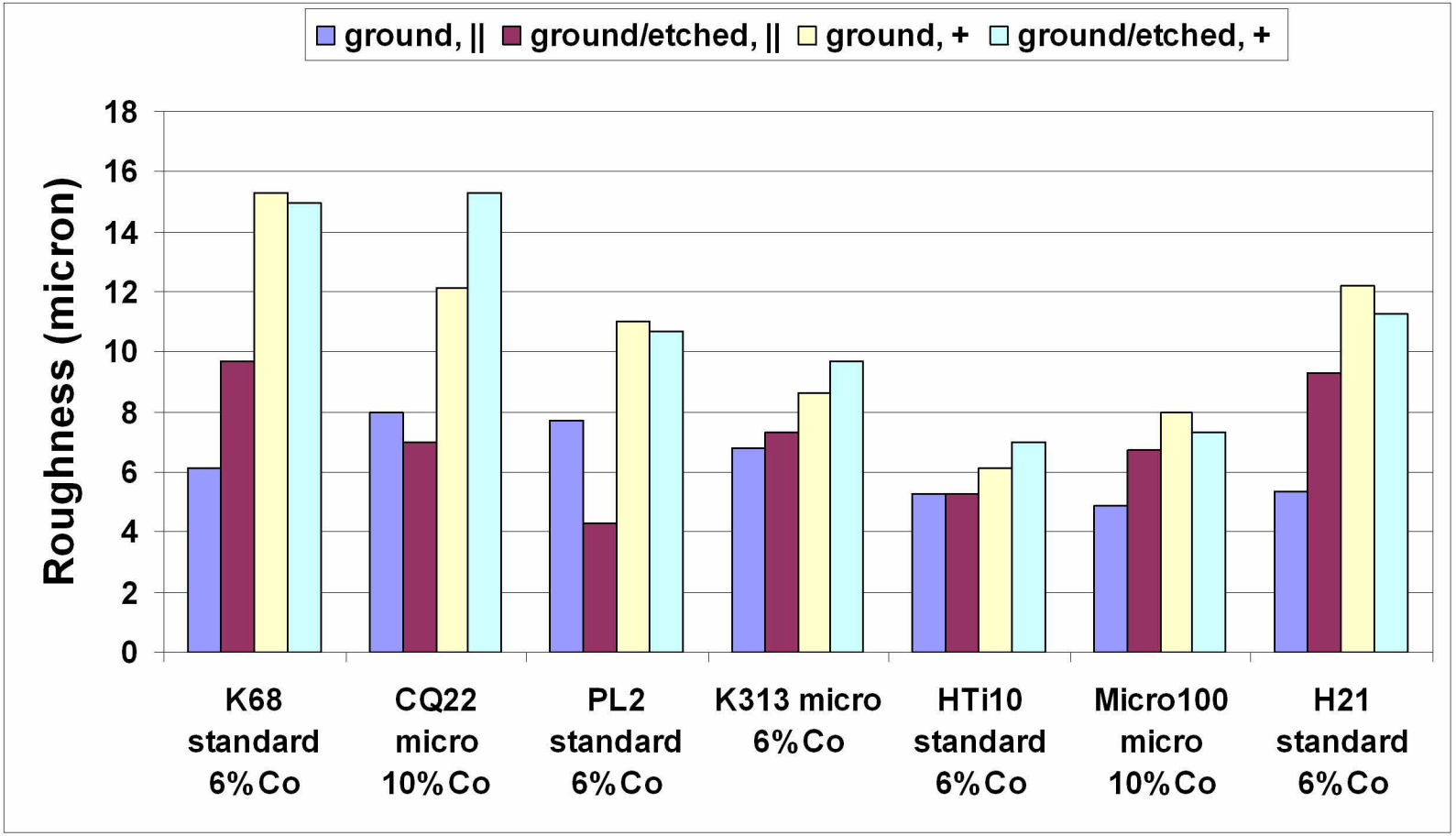
Results – Roughness of Ground and Etched Material



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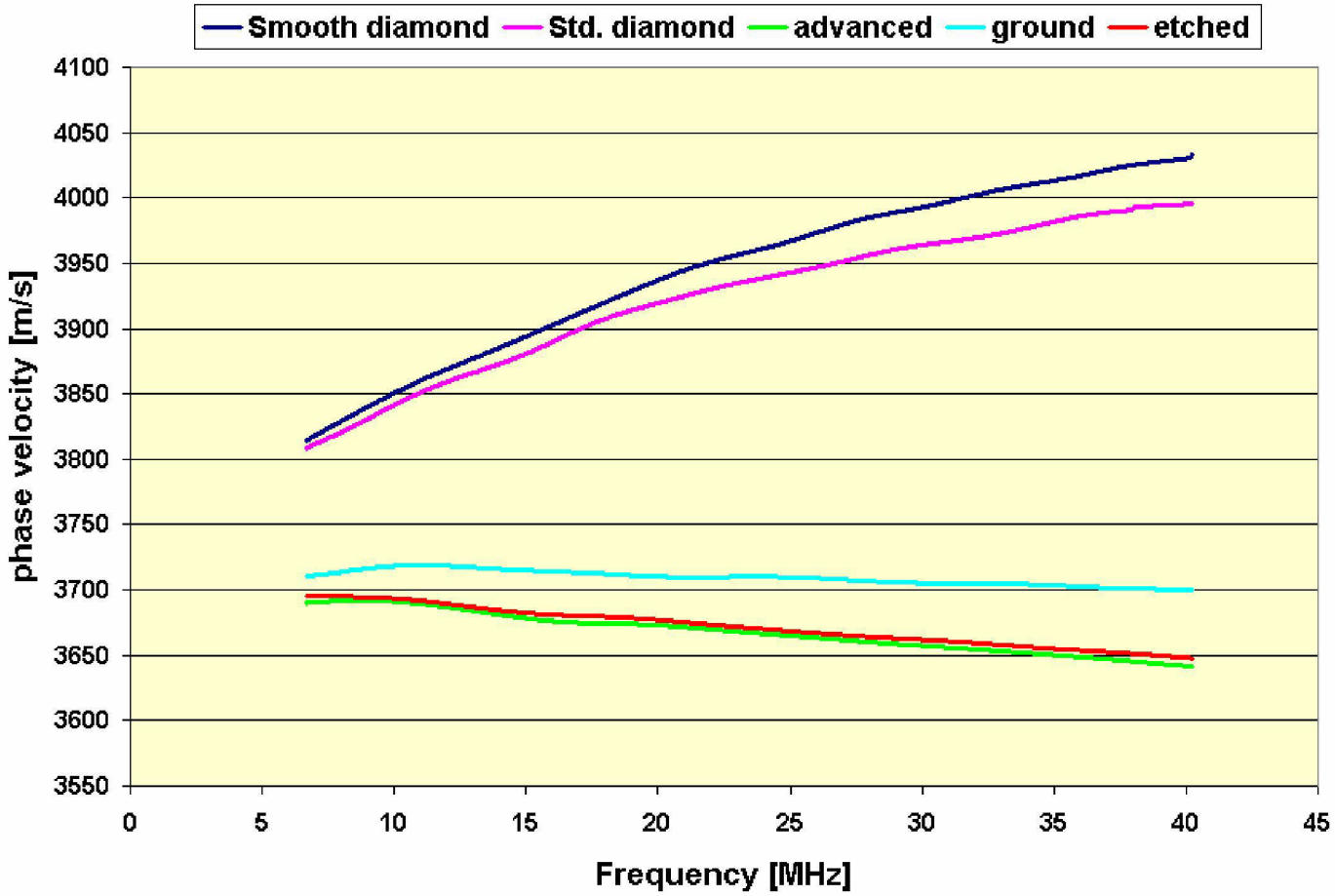
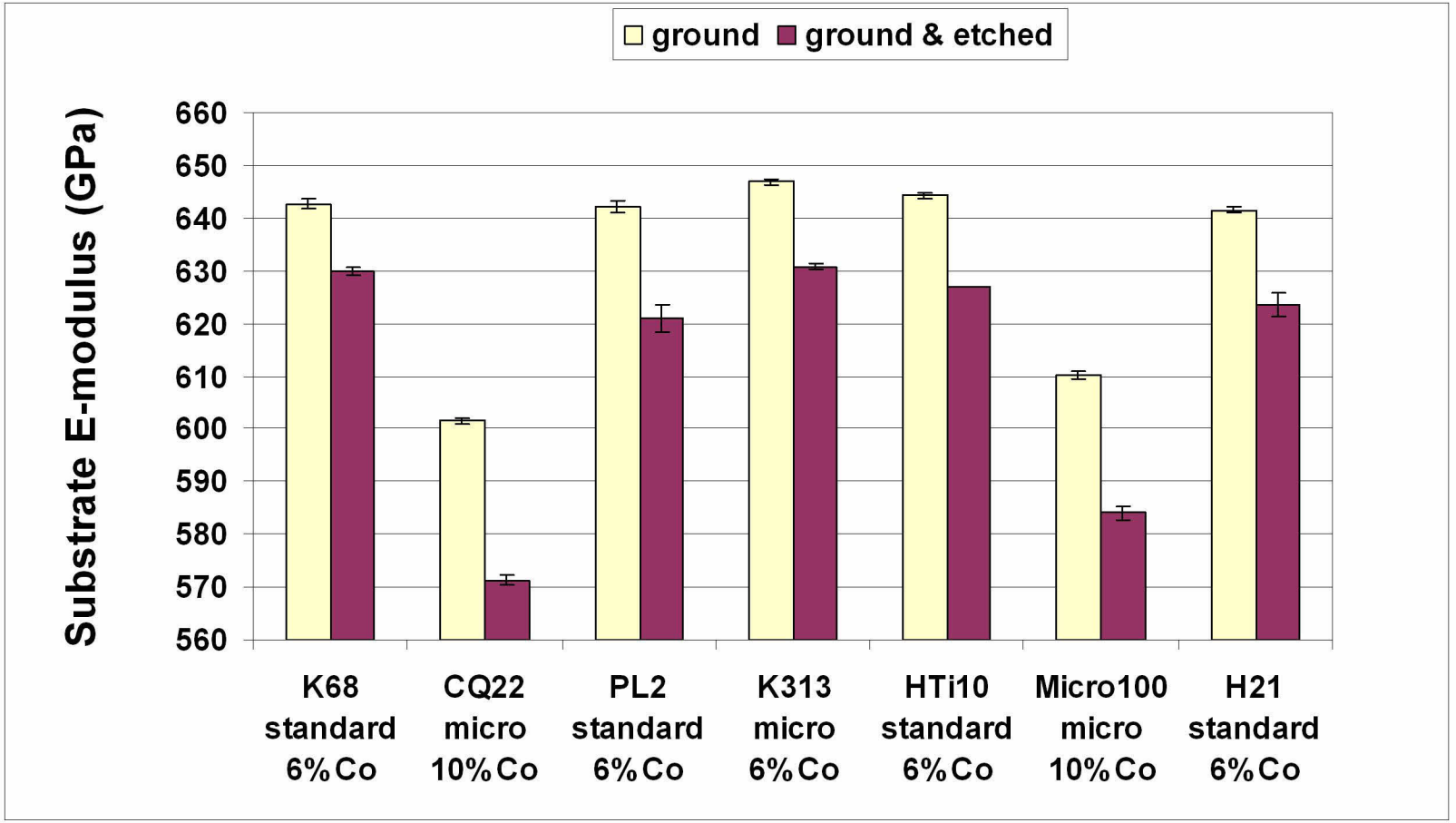
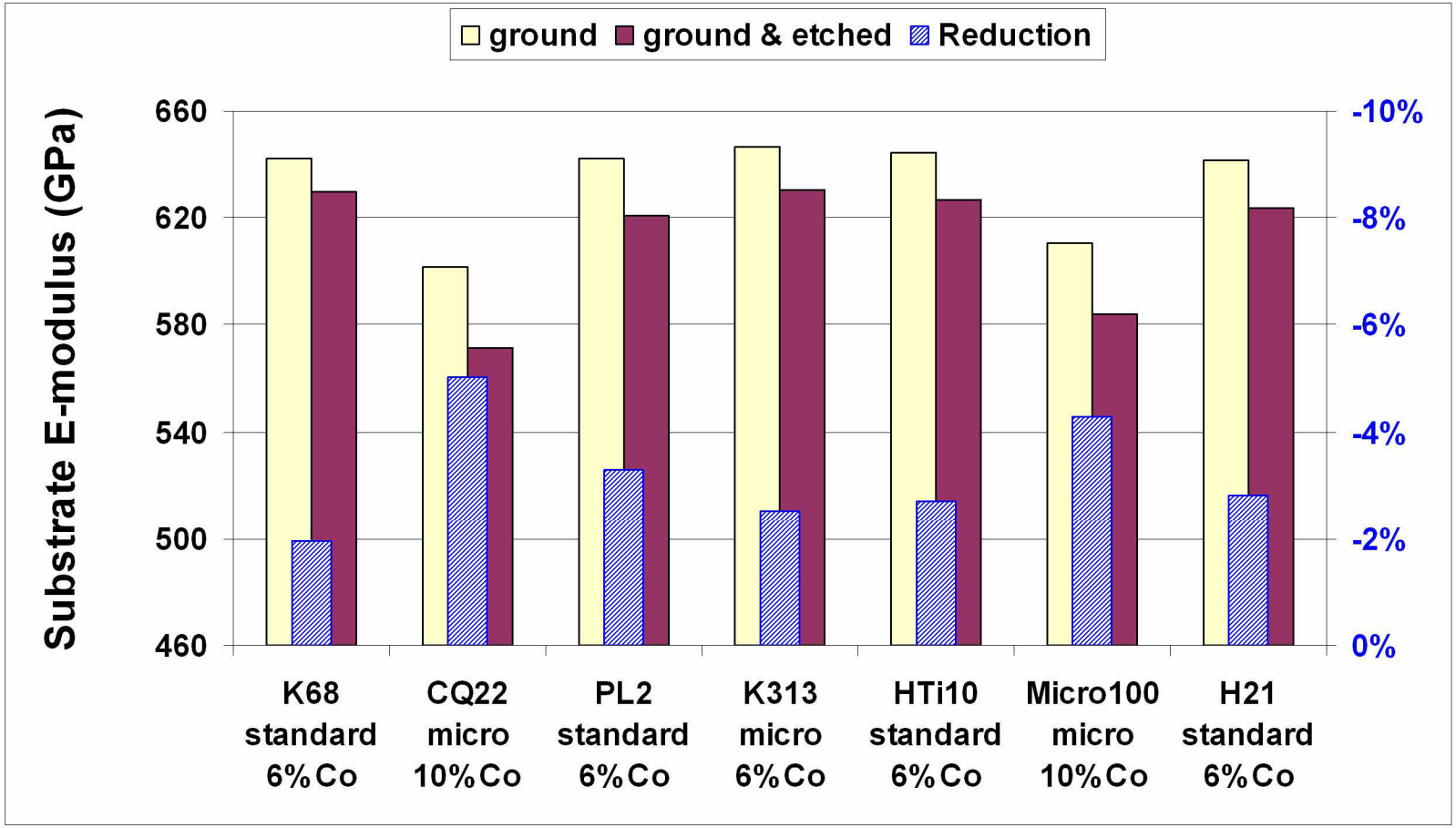
Results – Overview LAWave® Spectra



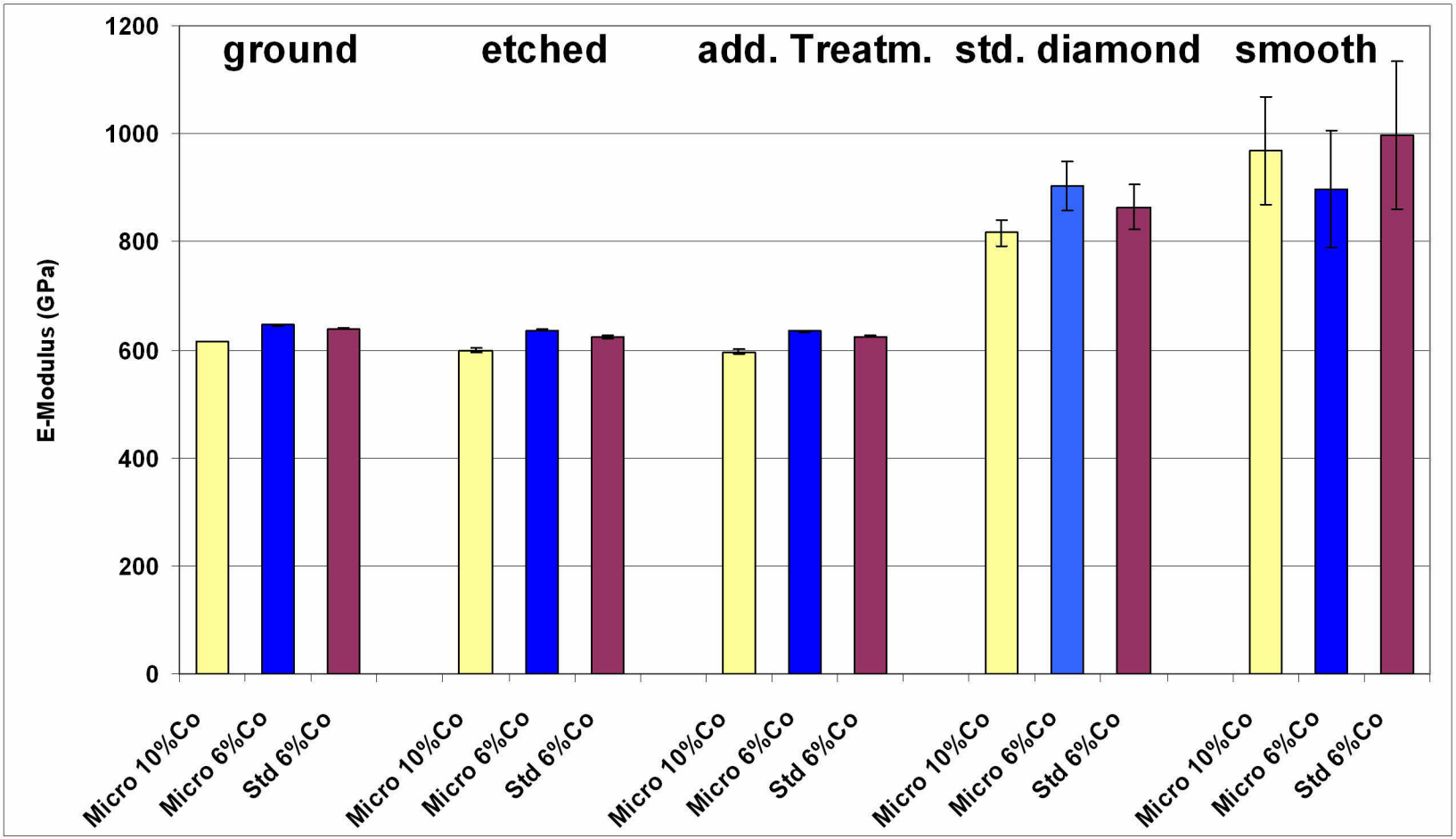
Results – Ground versus Ground & Etched Material (1)



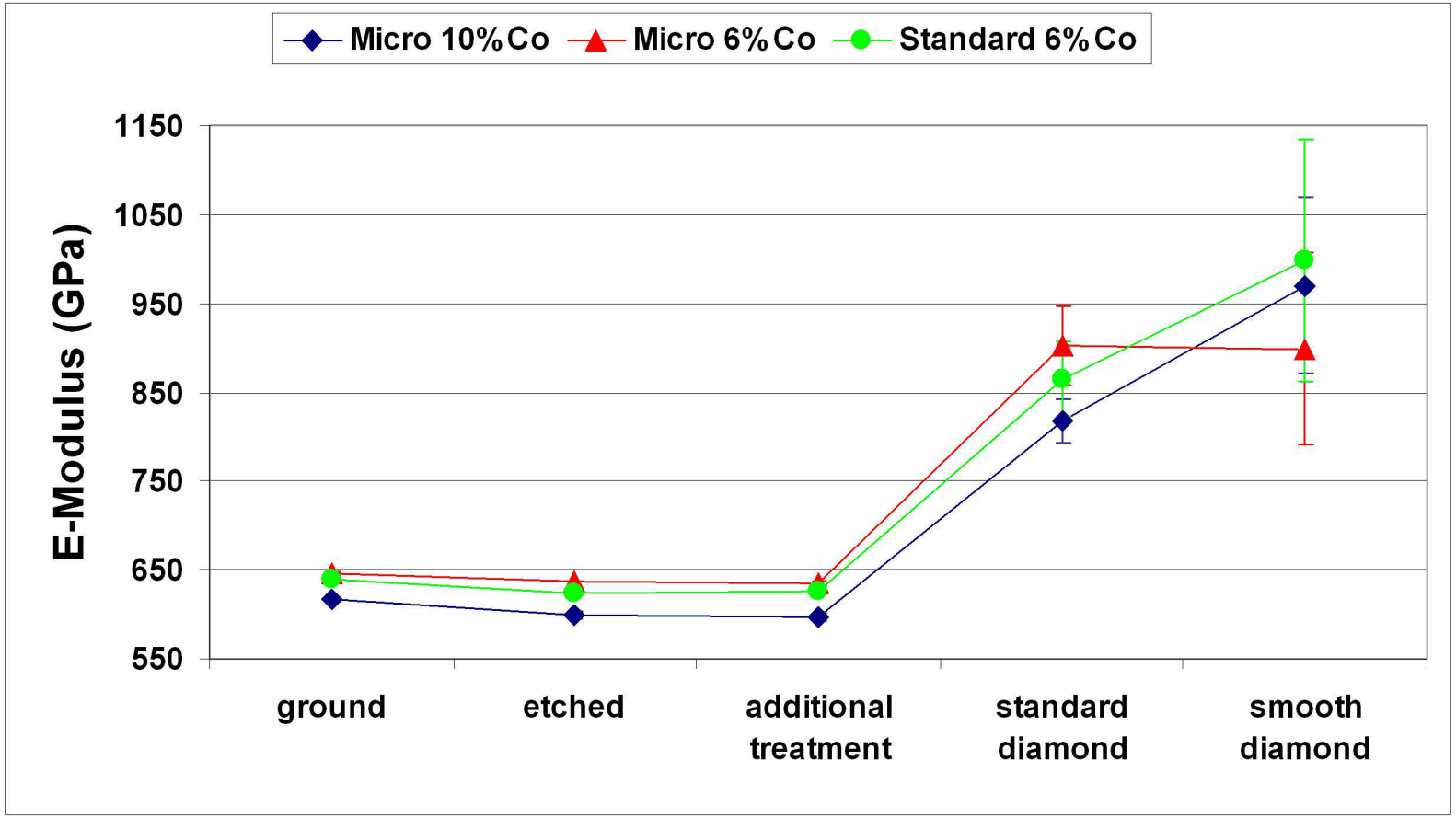
Results – Ground versus Ground & Etched Material (2)



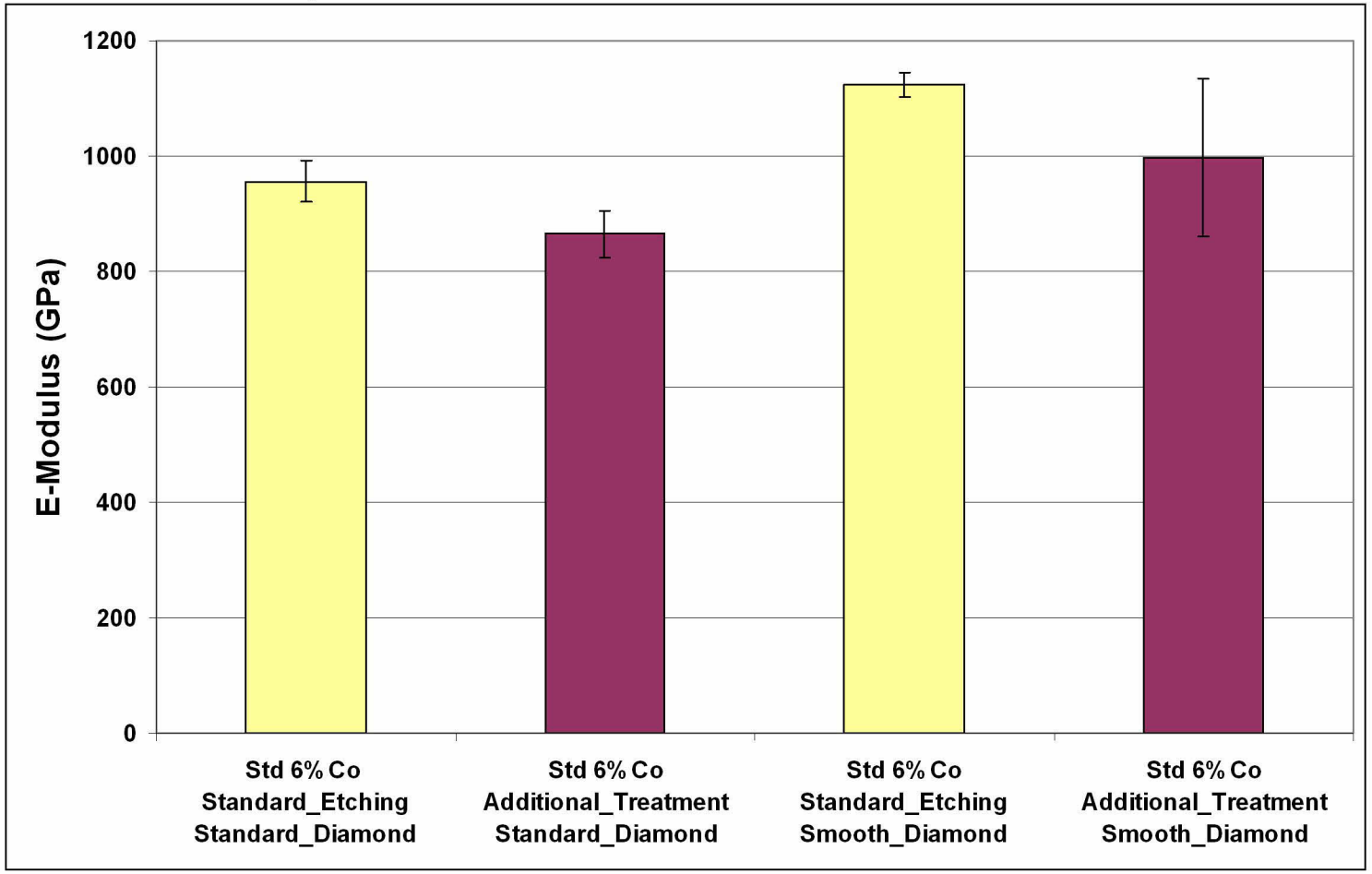
Results – Process Steps (1)



Results – Process Steps (2)



Results – Example Process Variations



Summary / Conclusions

- LAWave® as quality control and film development tool
  - Co% change from 5% ..10% very sensitively detected → can control incoming material
  - Effective E-modulus change due to etching (Co depletion) very sensitively detected → can control material prepared for coating
  - Effective E-modulus change due to different diamond coatings very sensitively detected → can control coating quality
  - Tool also proved successful to support film development
- Diamond coatings
  - Smooth diamond coating yields an effective E-modulus of (1123 ± 22) GPa

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