How to identify friction material properties, which are not isotropic and vary with loading?

**Material composition:**
- Reduced to full
- 5 cubical samples

**Previous work:**
- Friction material formulation
- Typical Young's modulus
- Compression modulus

**Observations/Strategy:**
- Some mechanical properties are known but not the corresponding mechanisms.
- Compression modulus is low compared to the metallic matrix / Role of the different components

**Two means of characterization:**
- Ultrasonic measurements
  - The mechanical behavior (Anisotropic)
  - Young modulus
- Macro indentation Brinell
  - Experimental data (Load-displacement)
  - The mechanical behavior (Anisotropic)

**Complexity of the problem:**
- Multi-components material
- Anisotropic morphology
- Multi-axial loading

**Conclusion & Outlook:**
- Model 3 (Anisotropy of MmCG1 Phase) ➔ Isotropic transverse global behavior
- Validation of the Brinell indentation tests and the reverse identification FEMU.
- In-situ multiaxial indentation test in a X-ray microtomograph to investigate/verify role of the components

**Acknowledgments:**

**Context:**
- High speed train: TGV.
- Mechanical braking system of the TGV.

**Mechanical characterization and modeling of heterogeneous friction pad material under multiaxial loading**

**Notation**
- Mm
- MmC
- MmCG1
- MmCG2
- MmCG1G2

**Components**
- Mn: 70%
- C: 10%
- G1 & G2: 20%

**Typical size (μm)**
- 100-600

**Compression modulus (MPa)**
- Mn: 10.3
- C: 2.5
- G1 & G2: 15.5

**Global behavior**
- Young modulus

**Two phases model:**
- MmCG1+G2

**Conclusion & Outlook:**
- Model 3 (Anisotropy of MmCG1 Phase) ➔ Isotropic transverse global behavior