

WINNING ON DURABILITY

Endurica User SPOTLIGHT

Beijing University of Chemical Technology (BUCT) is a National Key University known for its strong research focus, industrial partnerships, global engagement and international collaboration. BUCT's chemical engineering program is ninth in



the Academic Ranking of World Universities. The rubber science program has 300 students, with 100+ pursuing their Ph.D. through research in the Center of Advanced Elastomer Materials (CAEM) Lab.

Numerous scientific articles have been published in leading journals and multiple national awards have been attributed to work at the CAEM Lab.

The design of high-durability rubber materials and effective fatigue life prediction is the focus of the CAEM Lab. In the first systematic application of the Coesfeld Intrinsic Strength Analyser, a three-person team conducted characterization of natural rubber (NR) and polybutadiene rubber (BR) blend systems, including key parameters such as fatigue threshold, critical tearing energy, fatigue crack growth rate, and viscoelastic self-heating behavior.

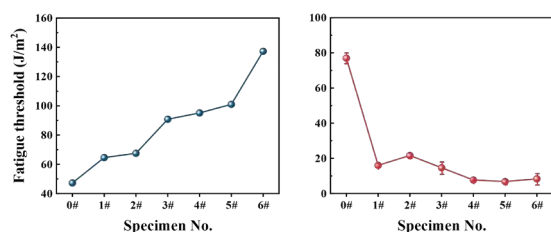


The investigation successfully obtained fatigue crack growth rate curves for rubber nanocomposites across a wide tearing energy range. The characterization study proceeded smoothly with the help of the ISA, which significantly enhanced our understanding of rubber fatigue behavior.

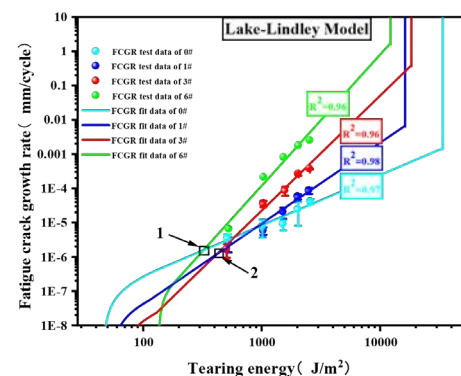
— Fanzhu Li, Ph.D.
Associate Professor
Beijing University of
Chemical Technology

PART 1: Validation of the Crack Growth Rate Curve

Robertson's Rule is a very useful way to quickly screen materials for crack growth behavior as it enables the estimation of a rubber crack growth rate curve based on the upper and lower boundaries T_c and T_0 . The Intrinsic Strength Analyser instrument measures both T_c and T_0 . The figure at right shows a validation case comparing the predictions of Robertson's Rule to actual measurements of crack growth rate behavior.



The very strong correlation to actual physical tests shown in BUCT's work confirms the utility of both Robertson's Rule and the ISA for quickly estimating crack growth behavior, as well as for screening materials for suitability to various uses. The BUCT work strongly validates this effective approach.



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PART 2: Versatility of the ISA

Polyurethane (PU) materials exhibit significantly higher hardness than most rubber materials. While investigating the PU fatigue threshold with the ISA, the excessive hardness and high Young's modulus of the material exceeded the measurement range of the ISA's blade and tensile sensors. To address this issue, the team reduced the sample thickness from the original 1 mm to 0.3 mm. The instrument was still able to obtain the critical information needed, even with a much smaller sample area.



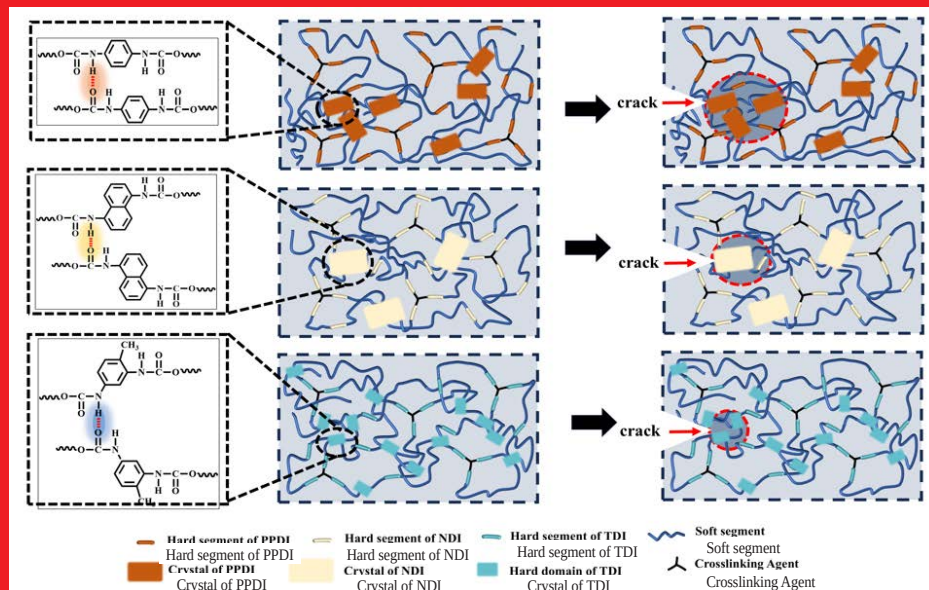
PART 1: Validation of the Crack Growth Rate Curve

Scan the QR codes to read the referenced studies.



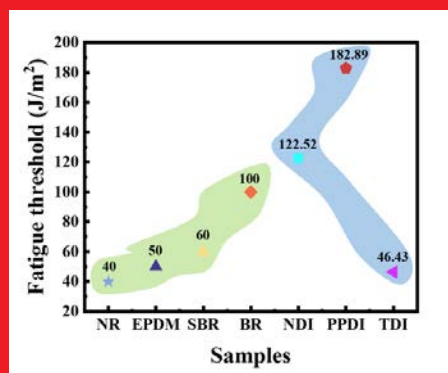
PART 2: Versatility of the ISA

POLYMER CHEMISTRY AND FATIGUE THRESHOLD



The Coesfeld Intrinsic Strength Analyser enables BUCT to study the effects of different polymer chemistries on long-term durability.

Experimental results demonstrate that PU with PPDI hard domain possess superior fatigue threshold compared to conventional rubber materials.



- ★ NR: Science 2021, 374, 212 - 216.
- ▲ EPDM: J. Appl. Polym. Sci. 1965, 9 (4), 1233-1251.
- ▲ SBR: Int. J. Fracture 1978, 14 (5), 509-526.
- ◆ BR: Int. J. Fracture 1978, 14 (5), 509-526.

Successfully achieving precise characterization of the polyurethane's intrinsic strength using the ISA illustrates the instrument's versatility and adaptability, thus opening doors to an even wider array of elastomeric material testing options.

— Fanzhu Li, Ph.D.
Associate Professor
Beijing University of Chemical Technology



Coesfeld Intrinsic Strength Analyser

- Measures the intrinsic strength of polymers through cutting forces on an instrumented blade of controlled sharpness.
- Delivers fatigue threshold results in hours, not months.
- Indicates the threshold fracture mechanical strength of a polymer network (i.e. the mechanical fatigue threshold).
- Based on the Lake and Yeoh procedure.