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# Analytical Mechanical Theory and High-Throughput Indentation Instrument

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## Abstract

The establishment of original principle-based theories and their expansion in experimental methodology systems play a decisive role in developing novel technologies for mechanical testing of small specimens and advancing scientific instrument innovation. Since achieving theoretical breakthroughs in 2016, our research team (led by Prof. Cai Lixun) has systematically established an analytical theoretical system for specimen-oriented elastoplastic mechanics based on the original energy density equivalence principle. This has enabled the successful development of a high-throughput mechanical testing method with robust theoretical foundations. By translating theoretical innovation into technological practice, we have overcome the technical bottlenecks of traditional mechanical testing in methodology, efficiency, and accuracy, completed the independent R&D of advanced high-throughput indentation instruments, and realized commercialization. These instruments have been applied across multiple fields including nuclear power, aerospace materials, material preparation, and service performance detection, highlighting their significant advantages in rapid material performance evaluation.

**Keywords**
Energy density equivalence; Analytical theory; Small specimens; Mechanical testing; High-thro-ughput indentation; Indentation instrument