XTALIC

XEFORM®

Nanostructured Nickel-gold for Semiconductor Test & Electromechanical Contacts

Every semiconductor produced today is individually tested before leaving the fab. Electrical spring contacts physically interface with each chip to power it up and verify functionality. As chips continue to miniaturize, probe pins must do the same. Conventional probe manufacturing methods — stamping individual springs, plating, and manual assembly — are now approaching their physical and economic limits.

Xtalic's XEFORM® is designed for a next-generation approach: contacts are fabricated directly on a silicon wafer using semiconductor-style lithography (LIGA) with photolithographic precision. This approach requires no individual handling or assembly, just wafer-scale manufacturing of hundreds of contacts simultaneously.

XEFORM enables miniaturization by combining the mechanical spring performance of high-strength alloys with the electrical conductivity required for reliable chip test.

Benefits

Unmatched spring performance: High yield strength and optimal elastic modulus deliver consistent contact force across millions of test cycles

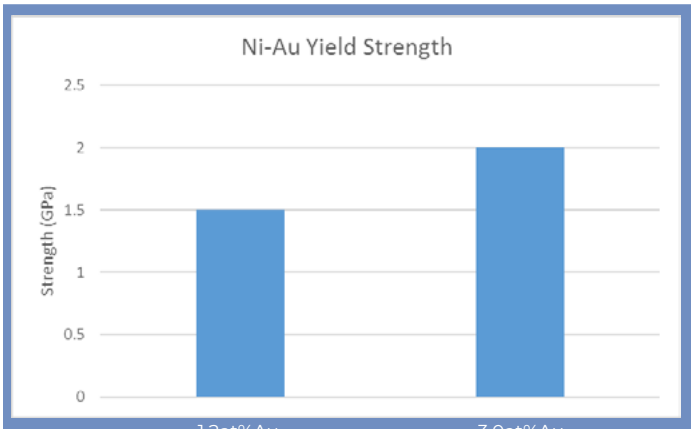
Next-generation miniaturization: Enables LIGA-based electroforming at pitches unreachable by conventional stamping or machining

Near-nickel conductivity: Carries chip test current without excessive heat, maintaining signal integrity throughout testing

Enhanced Reliability: Thermally stable to 400°C, preserving mechanical and electrical properties under continuous use

Precious metal compatible: Accepts gold and noble metal top coats for extended low contact resistance over probe life

Lower total cost of ownership: Wafer-scale manufacturing eliminates the labor and yield losses of individual contact assembly



Ni-Au tensile strength for the two alloy options

Key Features

Nanocrystalline grain structure: 10–20 nm grain size drives yield strength to 1.5–2.0 GPa while maintaining a 130 GPa elastic modulus

Industry-leading elastic stored energy: Yield/modulus ratio of 1.1–1.5%, outperforming Cu-Be alloys (1.0%) — the key figure of merit for spring contact design

Gold grain boundary segregation: Au concentrates at grain boundaries, preserving ~10 μΩ·cm conductivity and preventing grain growth at elevated temperature

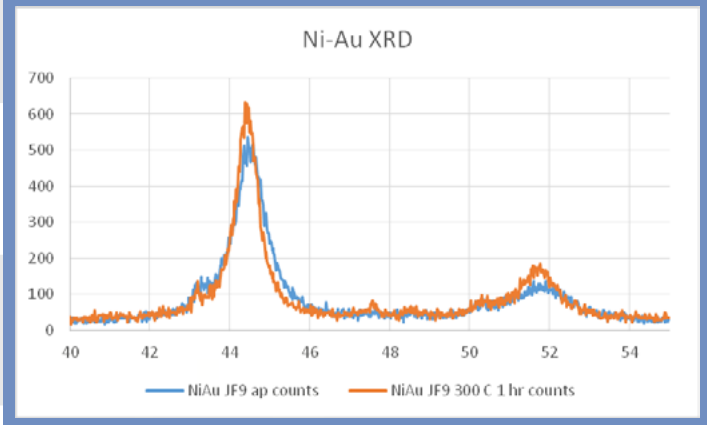
Two alloy compositions:

- Ni-1.2 at% Au: 1.5 GPa yield strength, 1.15% elastic stored energy; optimal balance of strength, conductivity, and ductility
- Ni-3.0 at% Au: 2.0 GPa yield strength, 1.54% elastic stored energy; trading some ductility for maximum strength in demanding geometries

2× the fatigue life of Cu-Be: Fatigue limit exceeding 1 GPa, confirmed at over one million cantilever bend cycles with no cracking

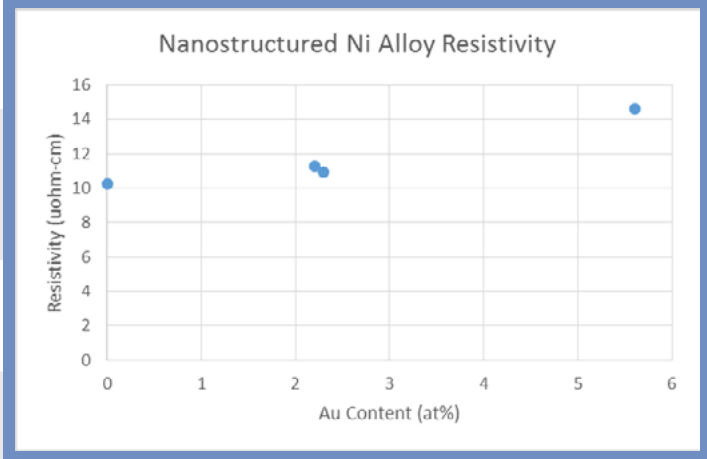
Thick electroform capability: Crack-free, void-free deposits to 400 μm in a single electroforming step

Process-ready deposit characteristics: Slightly tensile, low-stress plating produces dense, uniform deposits with consistent Au distribution batch to batch



Two theta angle (degrees)

XRD Spectra of Ni-Au showing super saturated solid solution nanostructure



Electrical resistivity of the electrodeposited Ni-Au alloy

Manufacturing Capabilities

- **Wafer-scale electroforming**
  Plates directly on silicon or PCB substrates with no individual handling required
- **Plating thickness**
  0.1 μm to 400 μm
- **Production format**
  Rack plating
- **Consistent alloy uniformity**
  Stable, uniform Au distribution across plated parts, compatible for complex geometries
- **Application engineering support**
  Pilot-scale sampling, process optimization, and on-site production support available

Applications

- **Semiconductor Test**
  - LIGA-electroformed probe cards
  - High-temperature test environments
  - Long-service probe fixtures
- **Electrical Connectors**
  - Spring contact beams
  - Connector interfaces
  - Reinforcement coating over lower-cost substrates
- **Advanced Electromechanical**
  - MEMS and precision spring elements
  - Quantum compute electrical contacts

Environmental Benefits

- **REACH compliant**
  No significantly hazardous materials, simplifying regulatory compliance globally
- **Additive process efficiency**
  Material deposited only where needed, generating less waste than stamping or machining
- **Extended service life**
  Fatigue resistance and thermal stability reduce probe replacement frequency and material consumption
- **Cyanide-free chemistry**
  Low hazard bath composition supports ESG and sustainability commitments