Fine pitch high performance needle probe concept using novel micro-plating technique

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Micrametals

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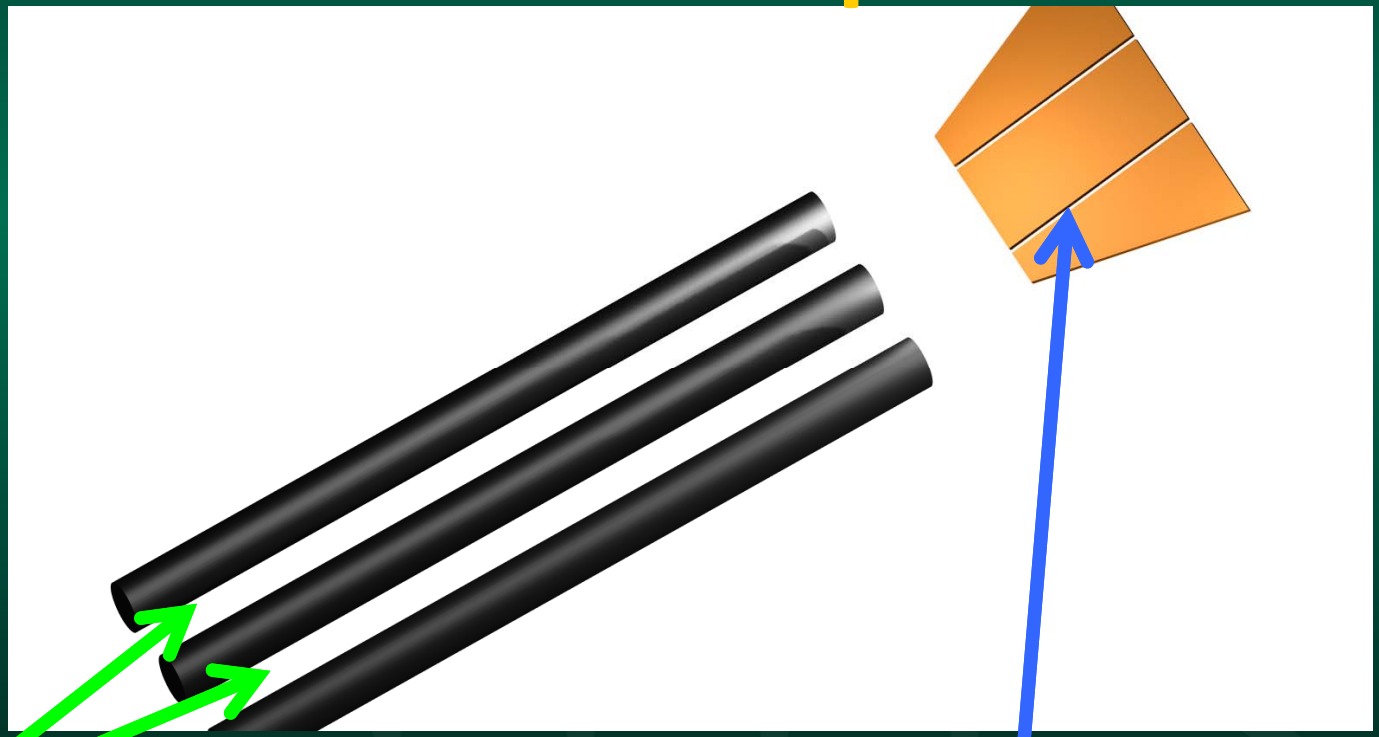
Introduction

- Existing needle probe technologies typically have long probe lengths with high inductance and non-50 Ohm characteristic impedance. They also do not readily allow for customization regarding scrub
- Simple 'conventional' probe construction technique sought that avoids these problems
- Applicable for moderate to fine pitch configurations
- Modular and field replaceable
- Low cost
- Rapid turnaround

Objectives

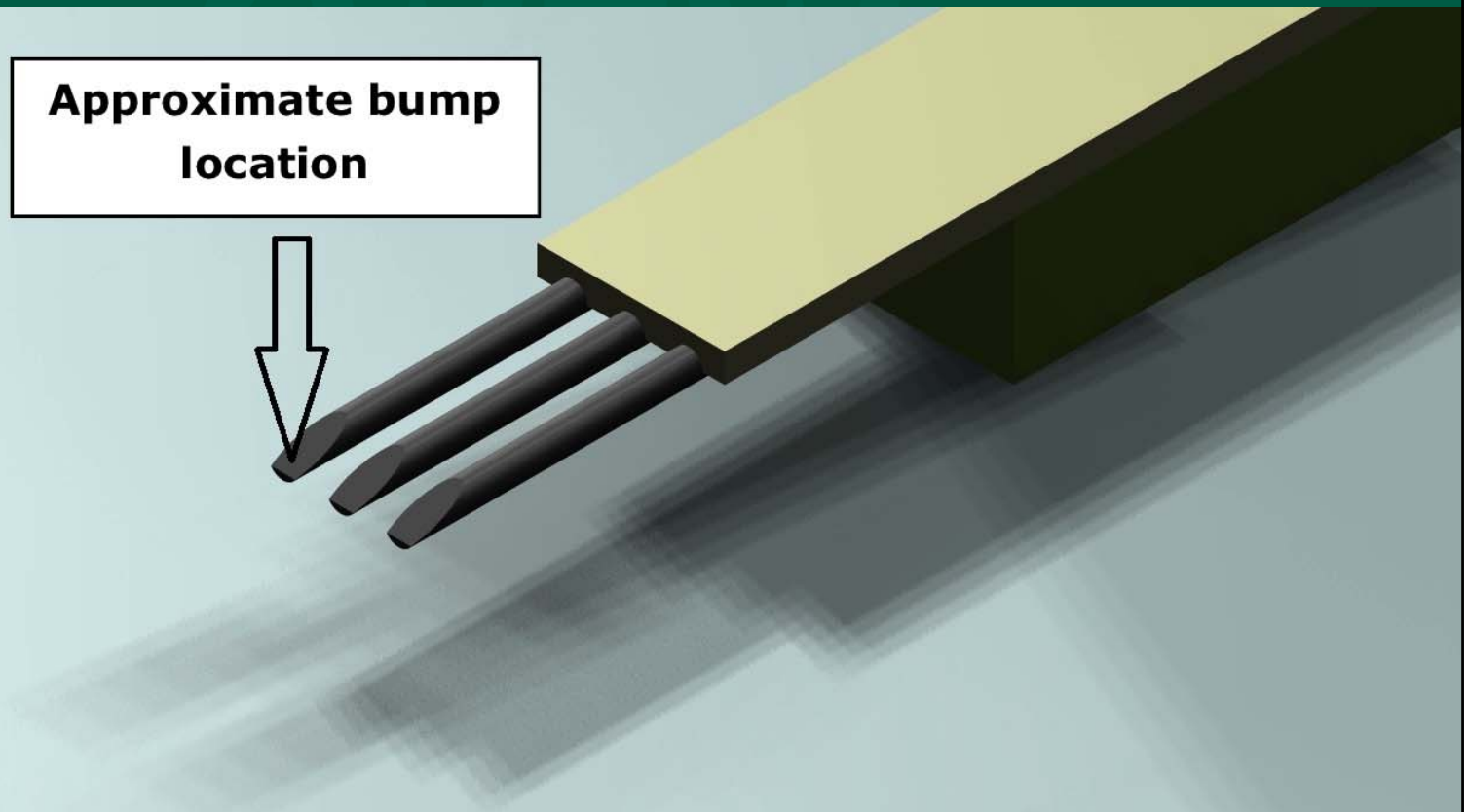
- **Define approach**
  - Needles with plated probe tips
  - Selective plating without the use of photoresist
- **Examine construction details**
  - Basic design
  - Plating technique
- **Devise prototype**
  - Mechanical/electrical models
  - Performance measurements DC and RF

One electrical problem



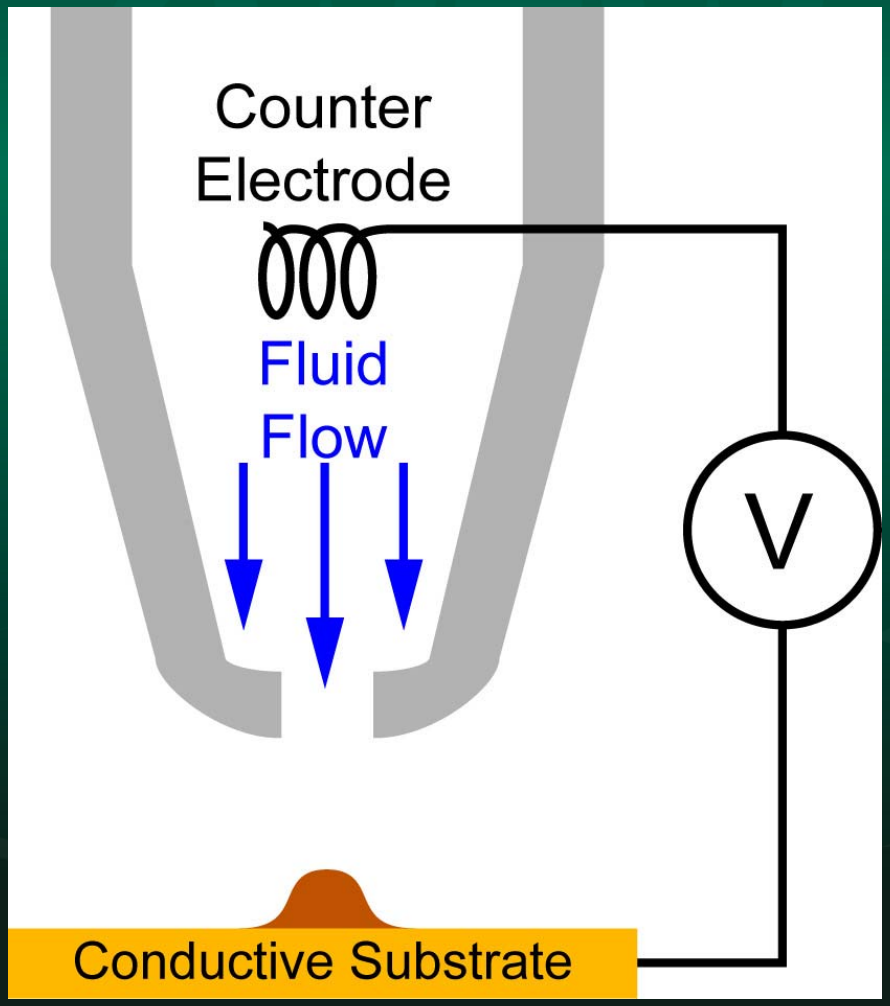
Air gaps typically render RF impedance far above 50 Ohms. In coplanar probes this is avoided by small cuts in sheets of conductor. This cannot be done here, which leaves mostly the addition of dielectric material between conductors as an option.

Approach



Bumps to be formed without photolithography

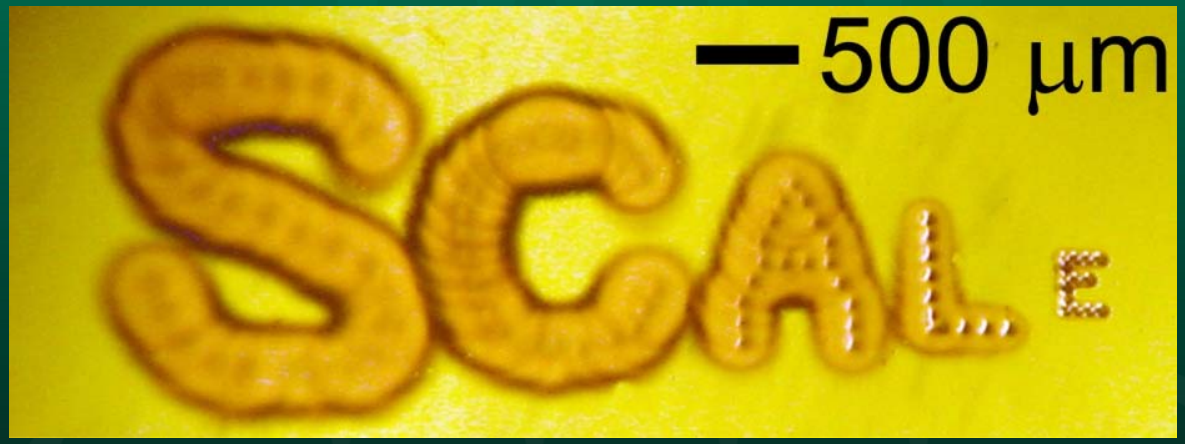
Microjet Plating Schematic



Localized Electrodeposition

Feature size

Multiple resolutions with one nozzle size



Resolution can be changed on-the-fly

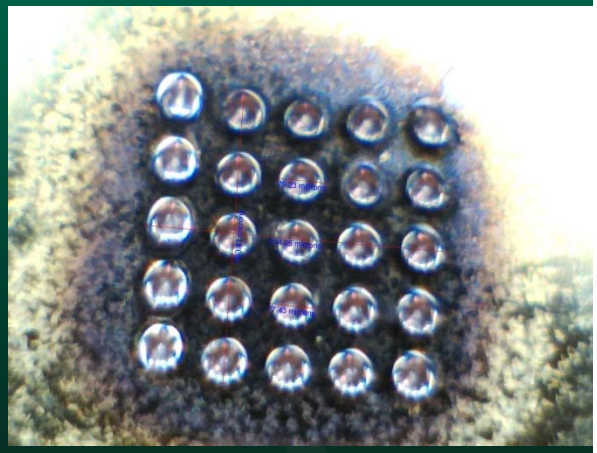
Materials

Others are easily implemented, including tunable alloys…

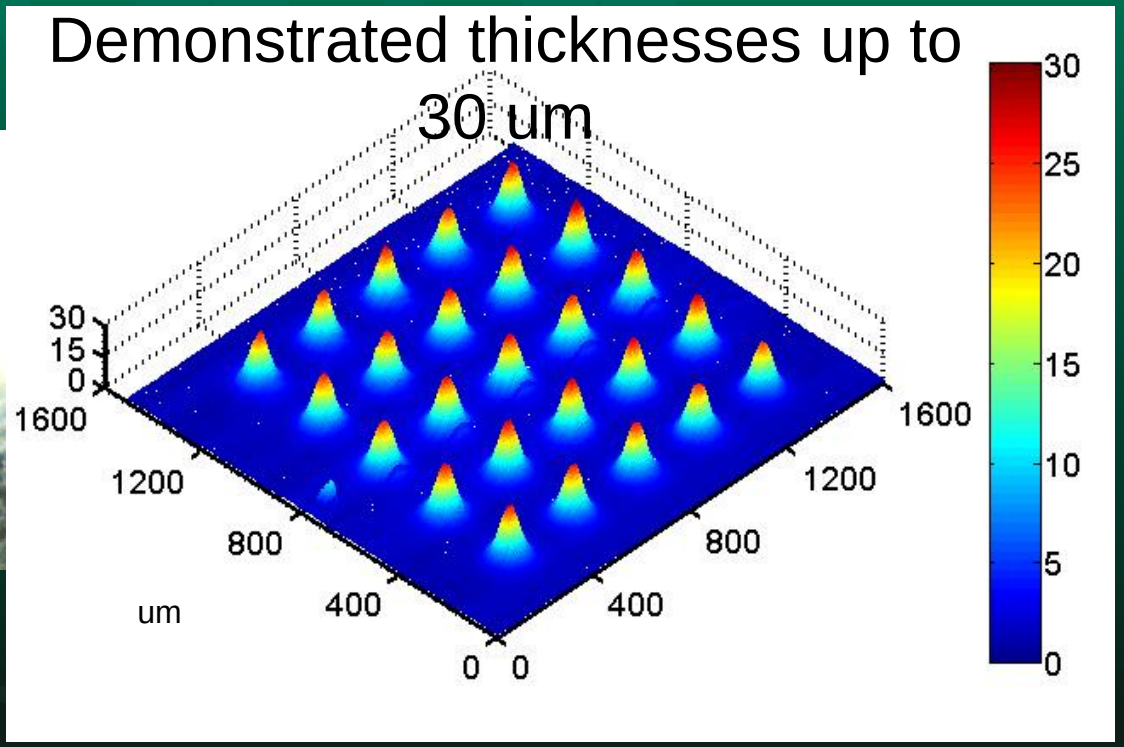
Material	Z-Growth Rate (um/min)
Copper	6-18
Nickel	1-8
Gold	2-10

Bumps

Nickel bump array

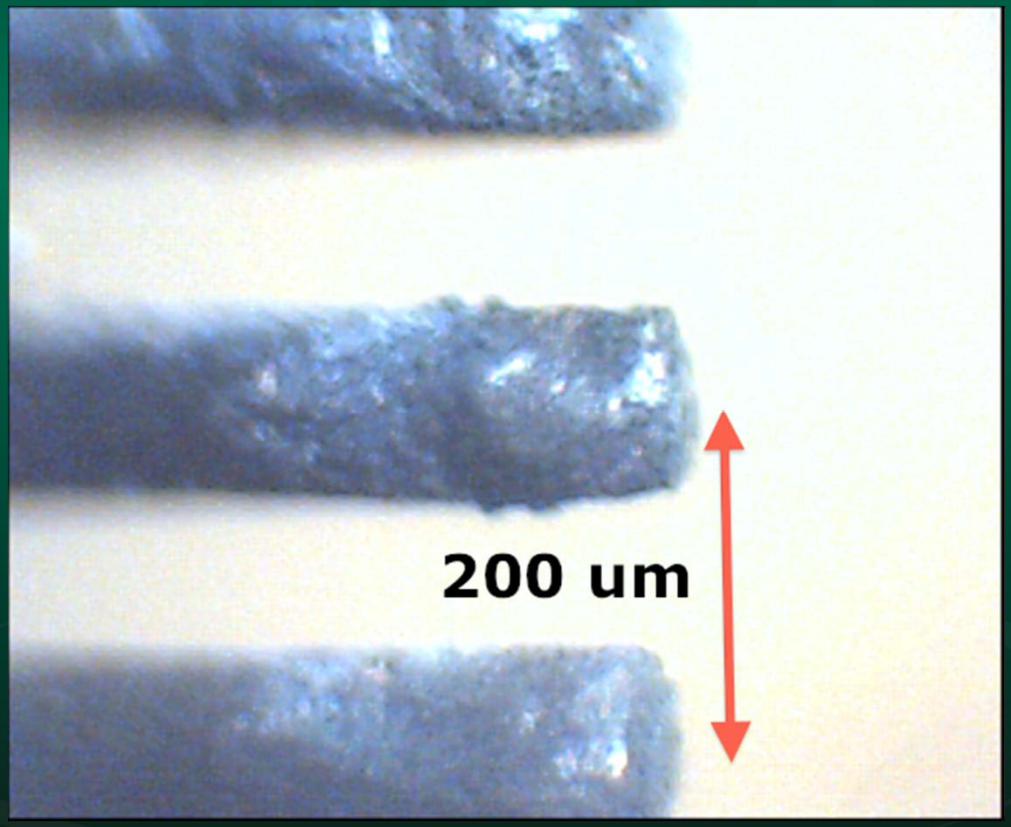


Demonstrated thicknesses up to 30 um



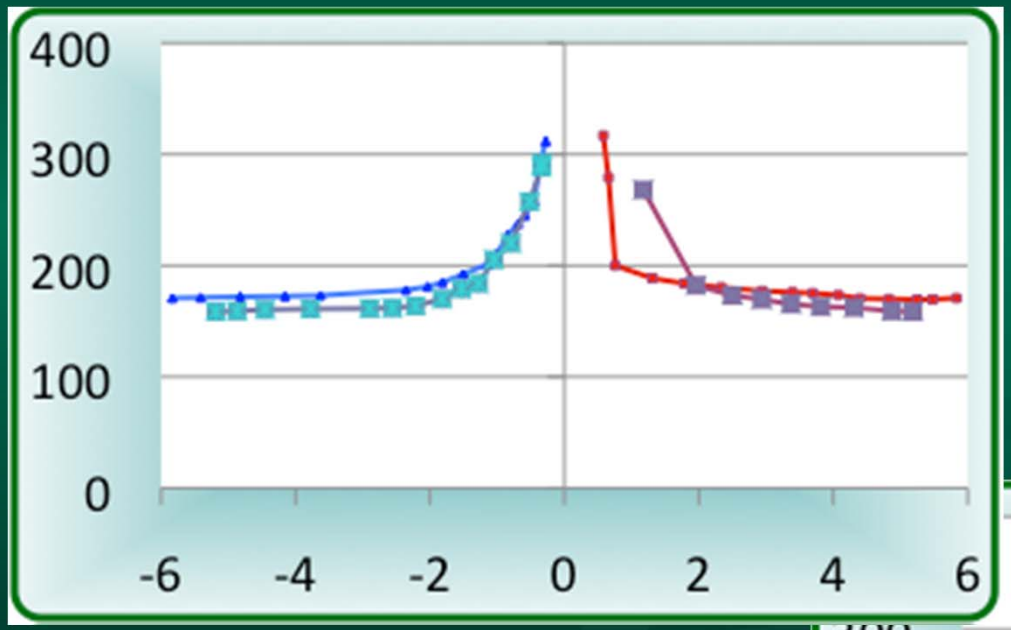
Overall process variability <10 percent of target

Bumps

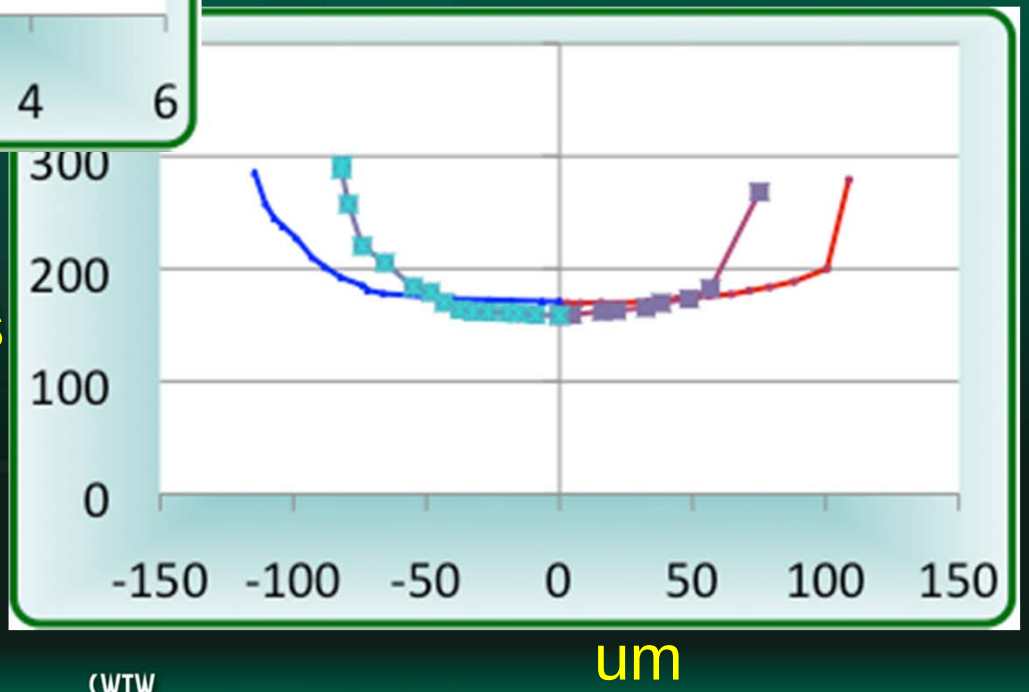


Bump height is approximately 10 um
Pitches to 100 um should be possible

Electrical, DC

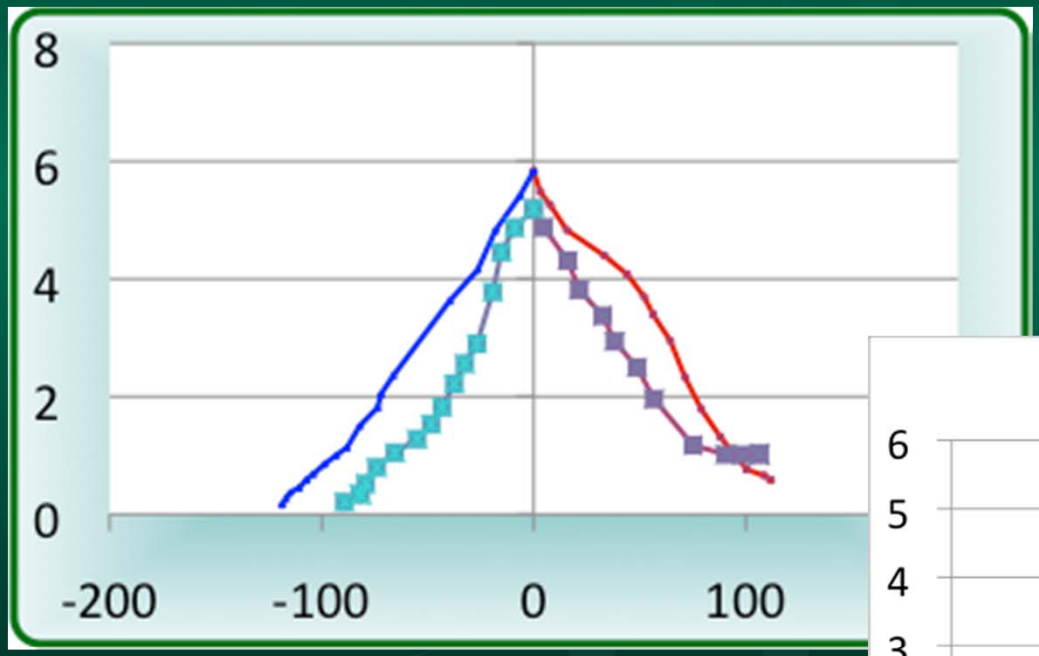


Measured resistance as a function of force and displacement shows stable performance



Mechanical

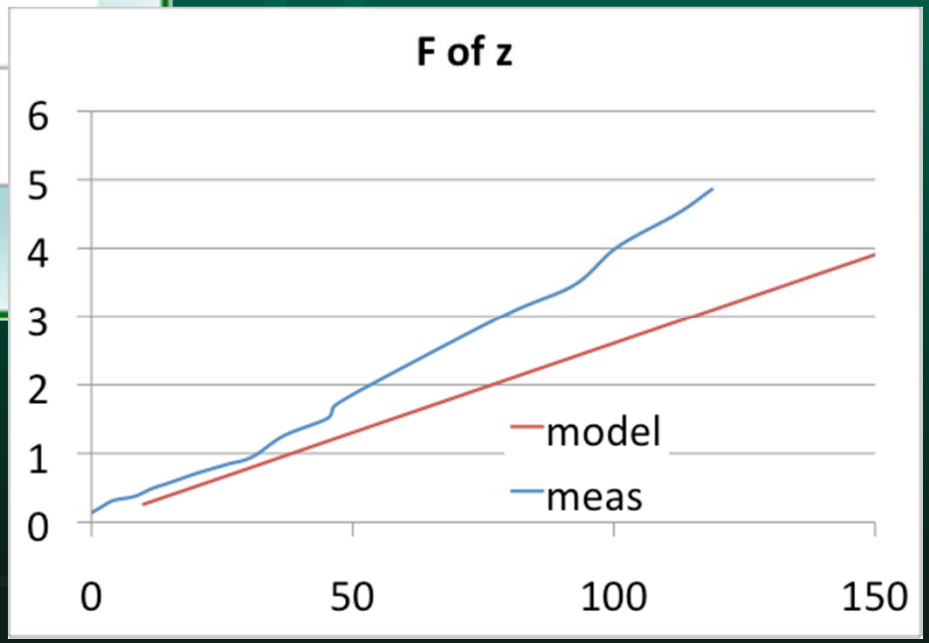
grams



um

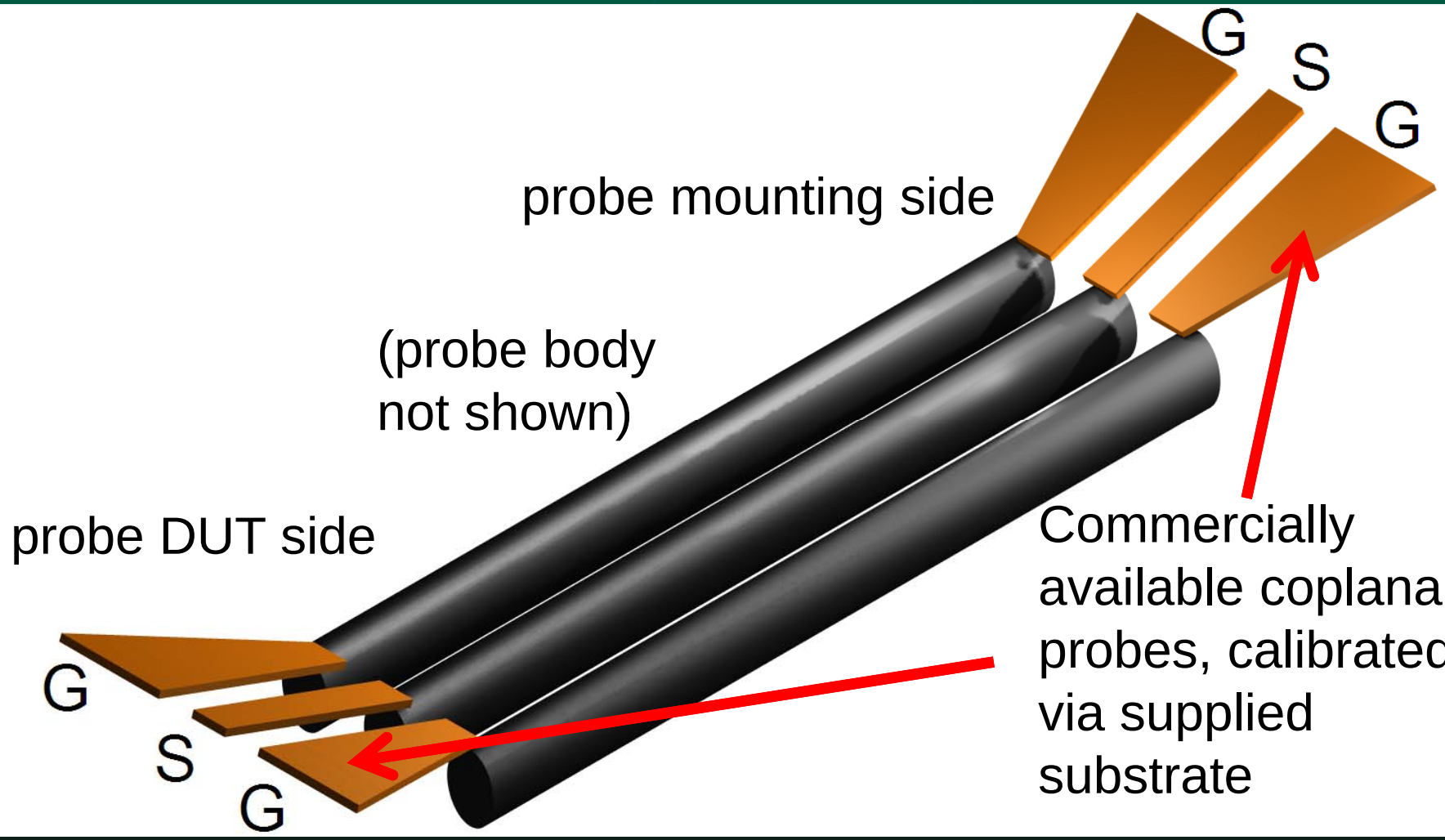
Measured force as a function of displacement

grams

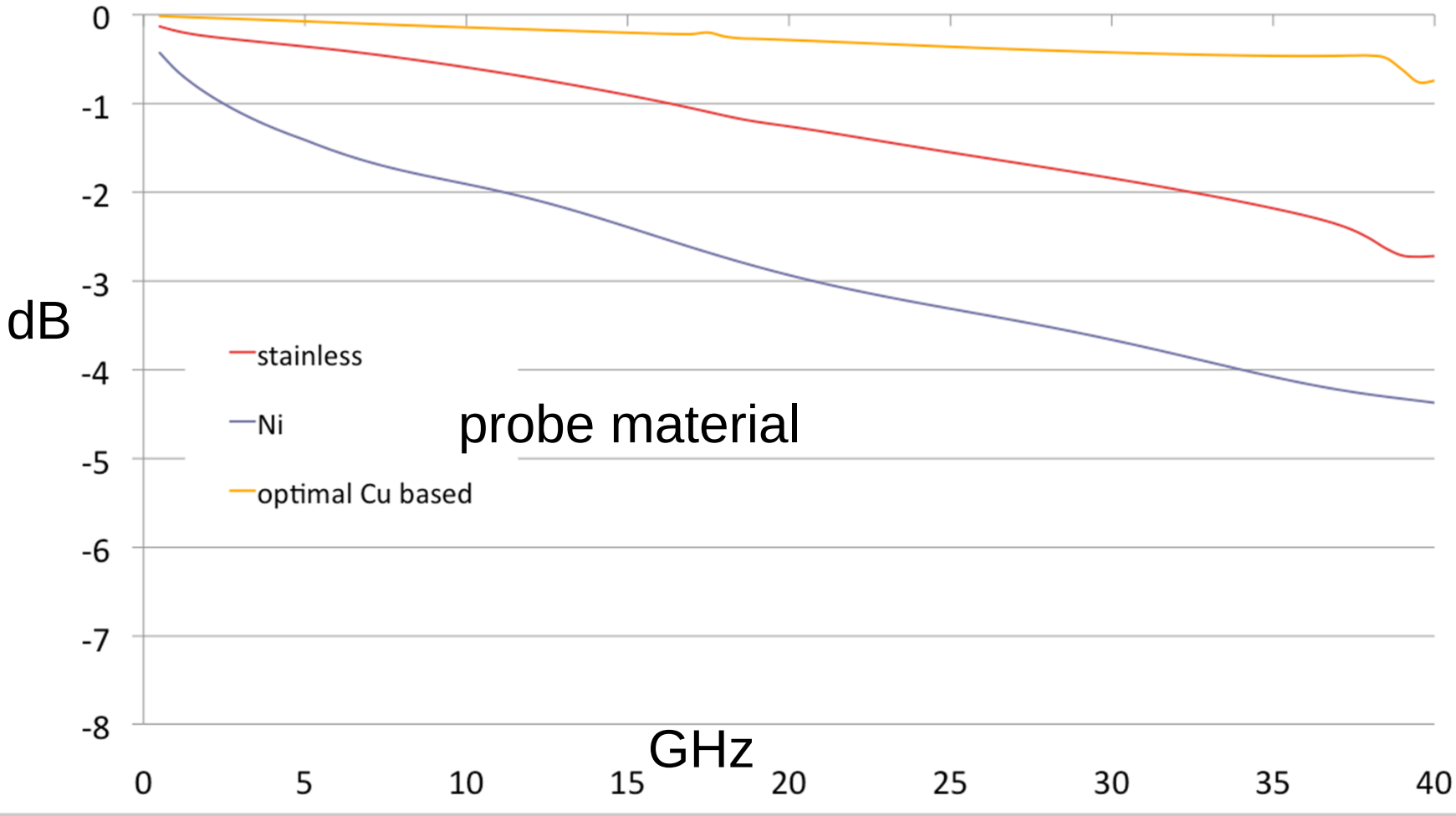


um

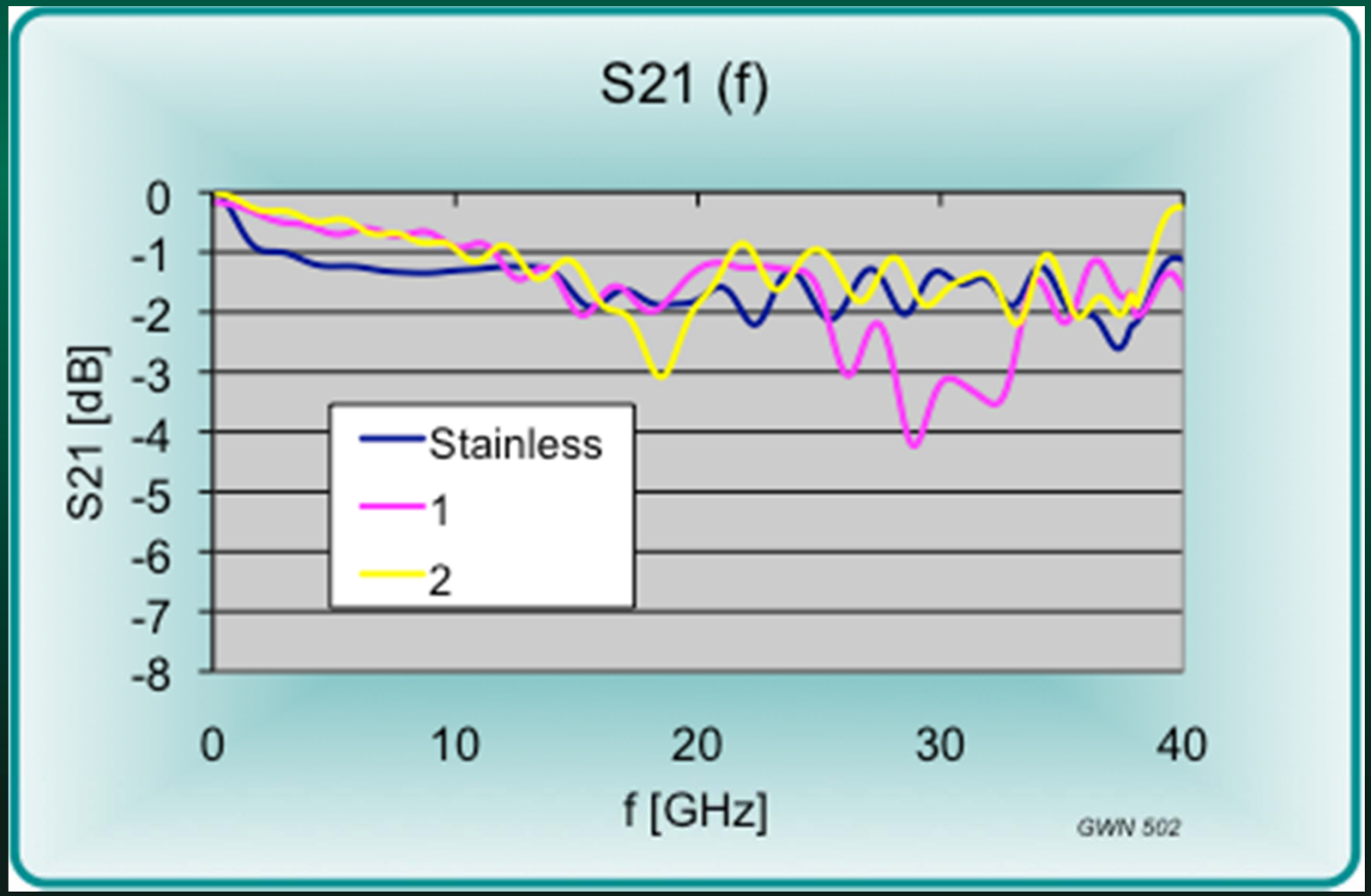
Configuration for RF models and test



HFSS RF insertion loss FEA model

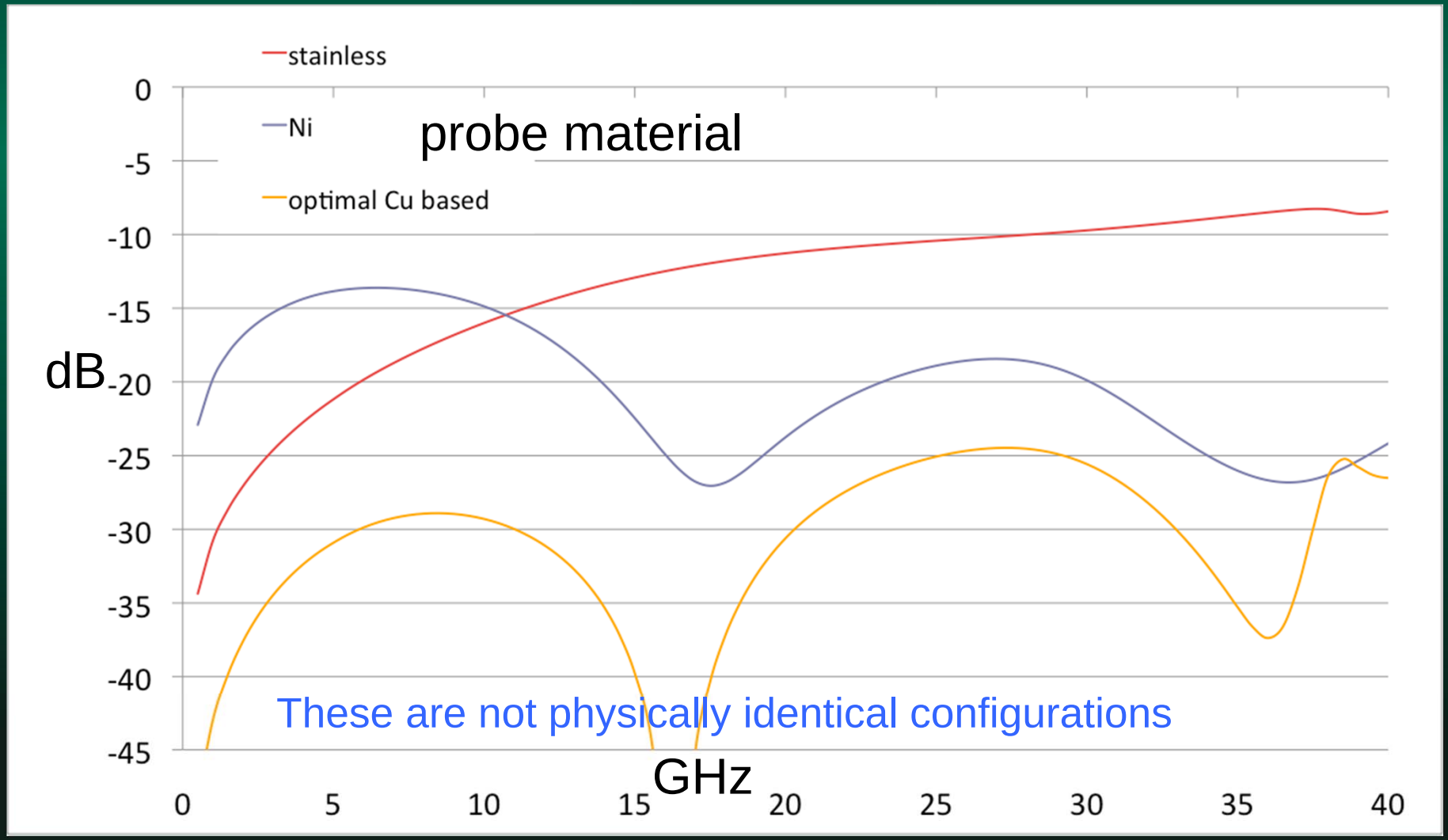


Measured RF insertion loss S21

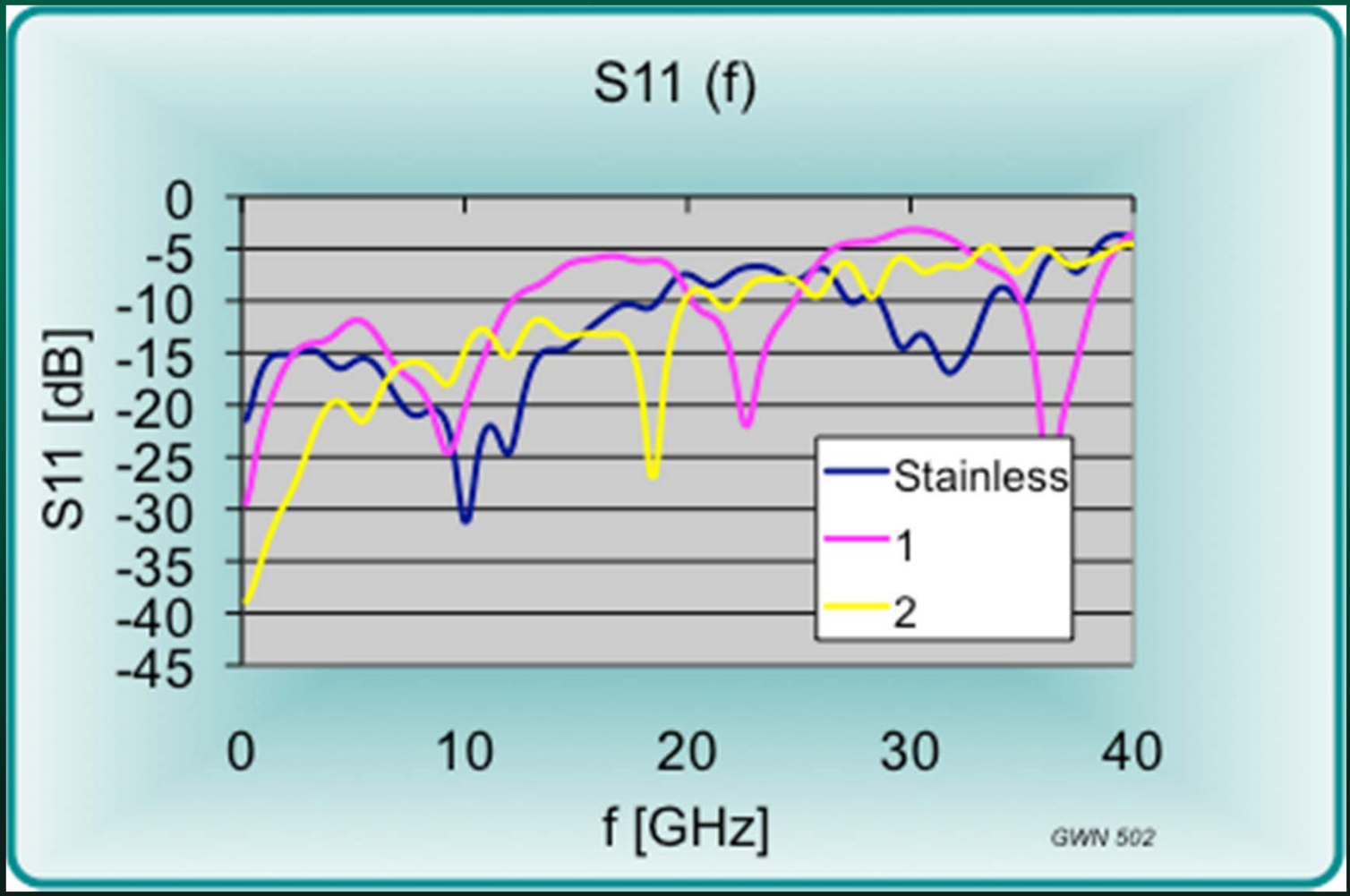


These are not physically identical configurations

HFSS RF model return loss S11

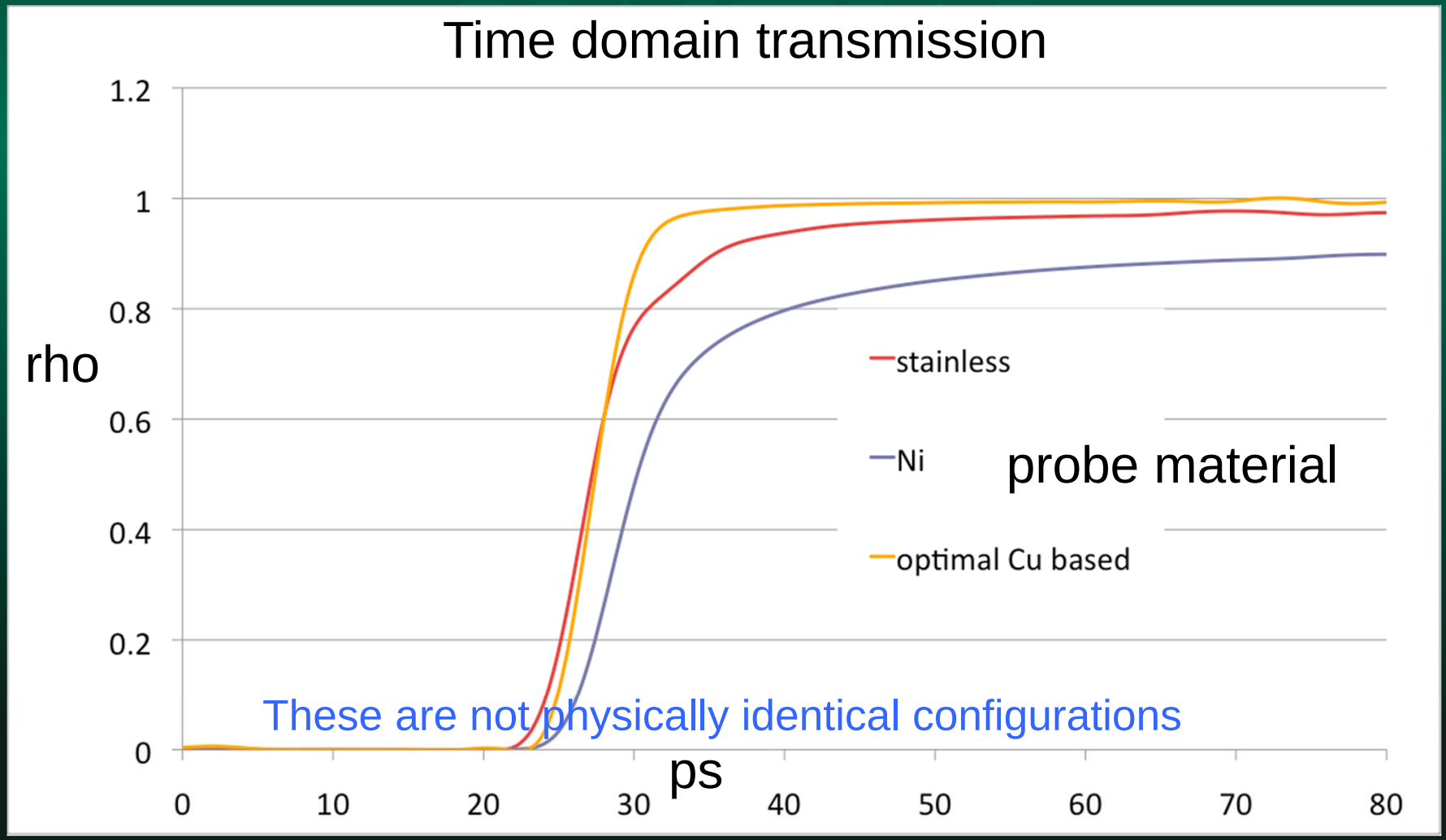


Measured return loss S11

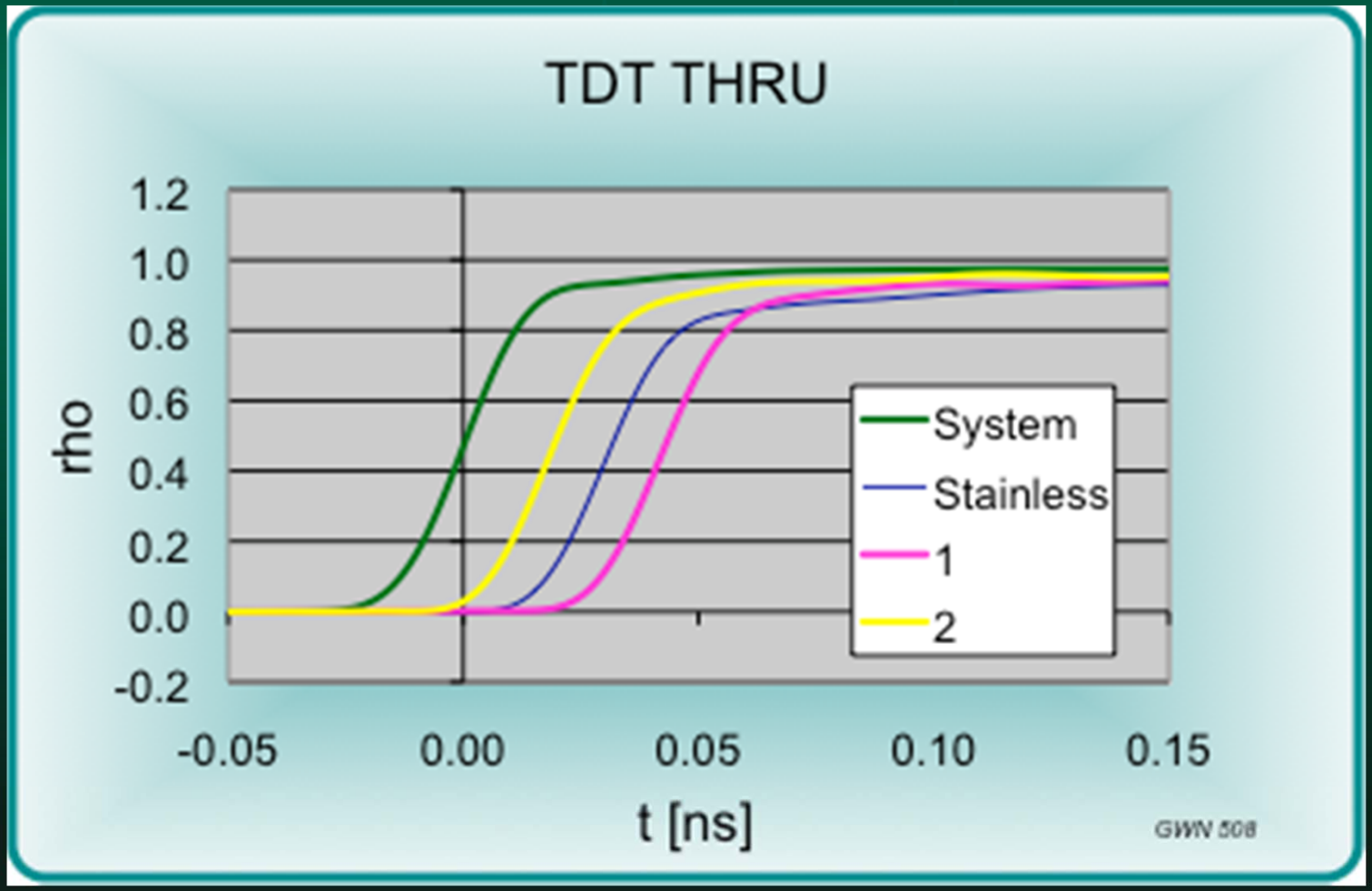


These are not physically identical configurations

HFSS TDT model

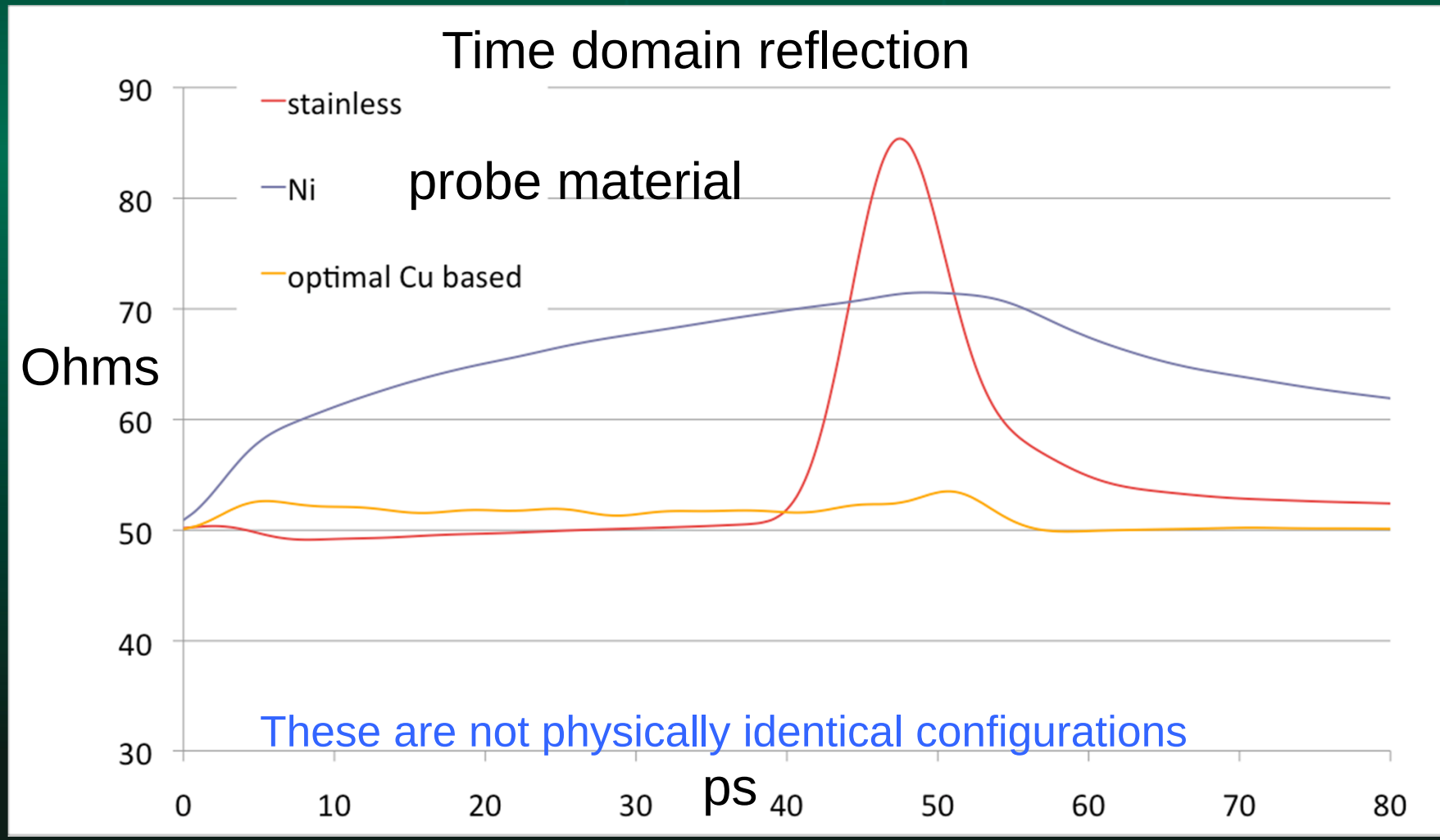


TDT measurement

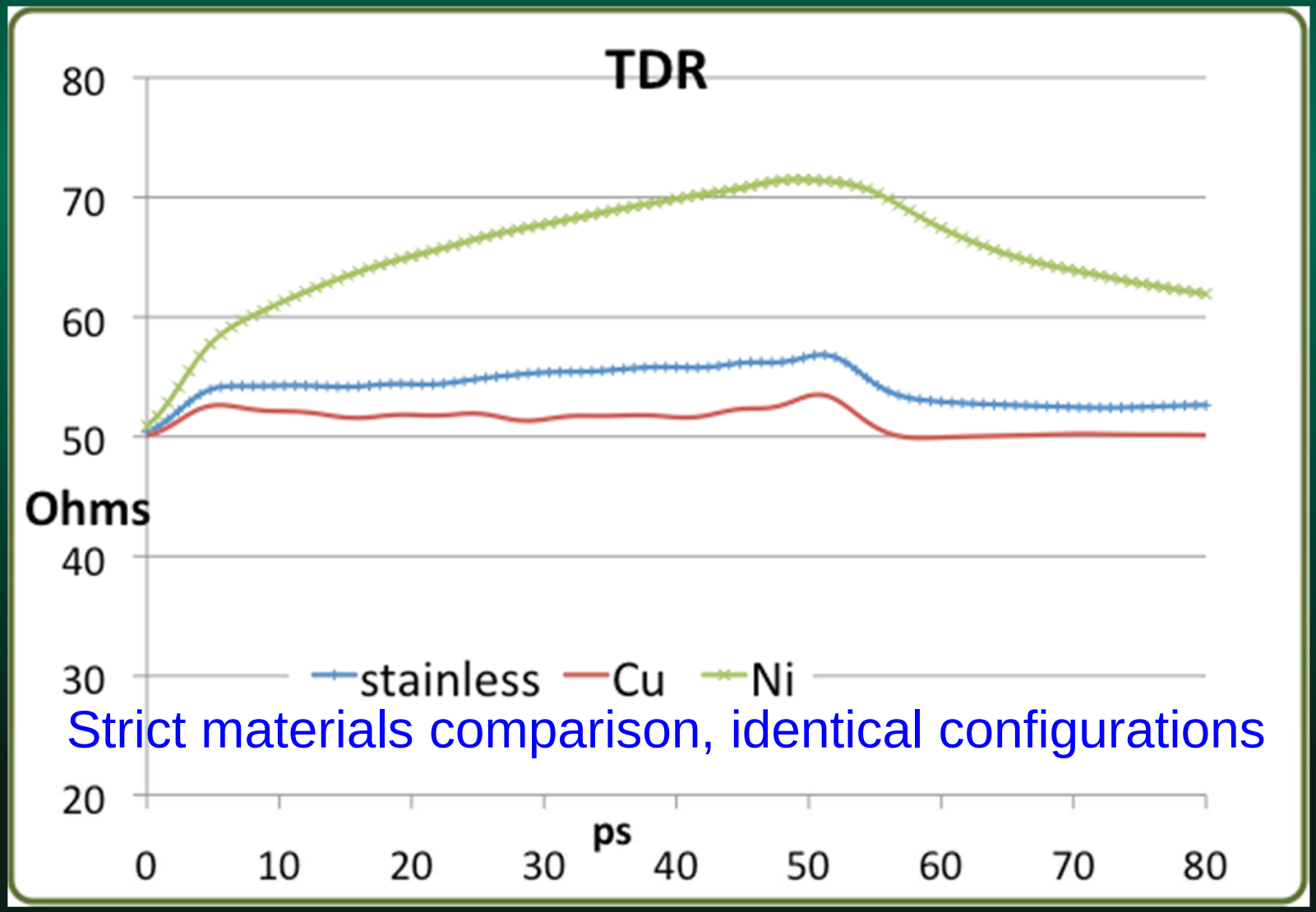


These are not physically identical configurations

HFSS TDR model

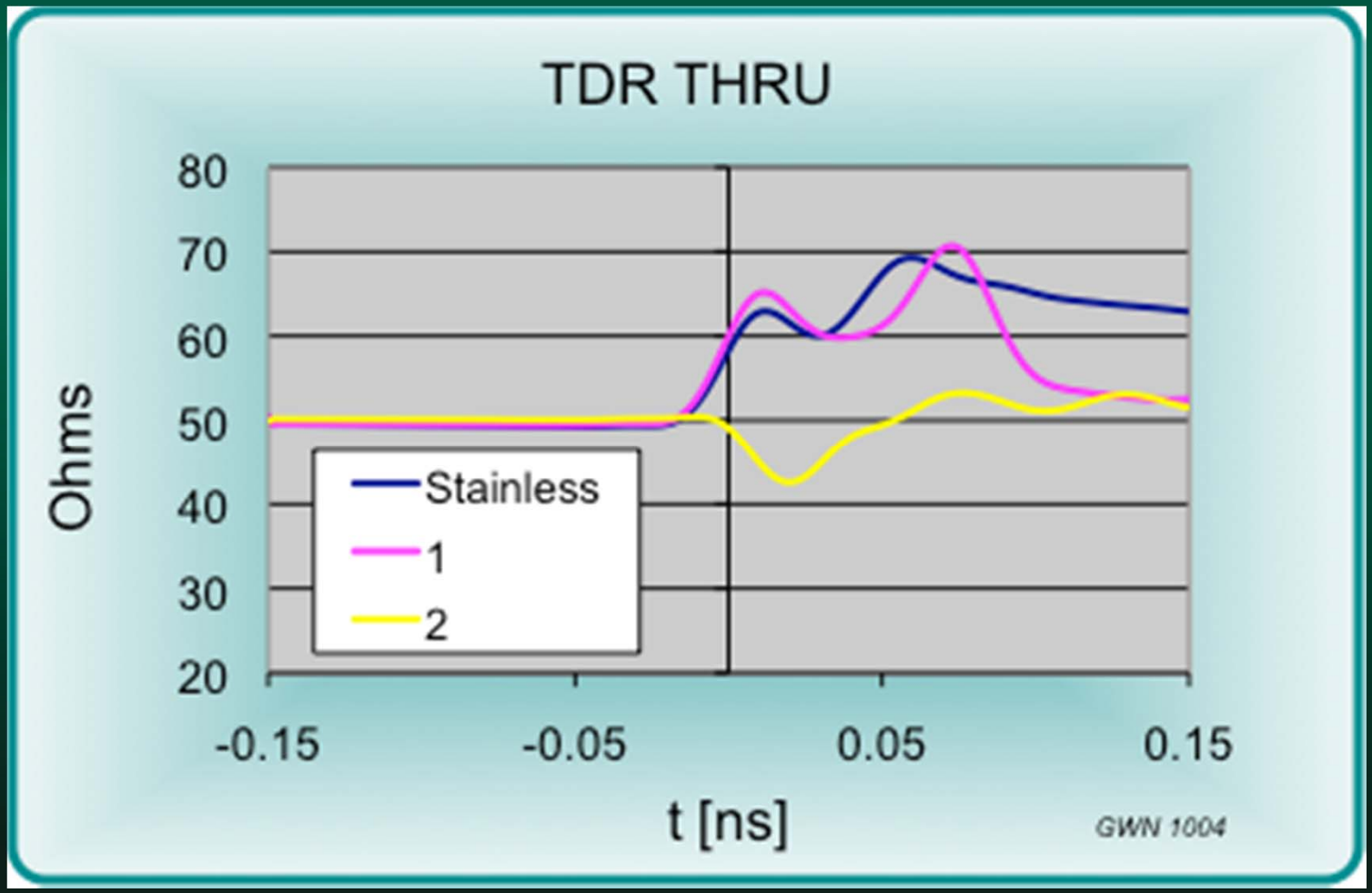


HFSS TDR model



Strict materials comparison, identical configurations

TDR measurement



These are not physically identical configurations

Conclusion

- **Basic approach appears feasible**
  - Simple low cost construction
  - Modular and replicable
  - Selective localized plating on freestanding probe possible
- **Good RF and DC performance**
- **RF performance can likely be further improved**
- **Next steps:**
  - Full assembly
  - X4 probe head