# AHEAD OF WHAT'S POSSIBLE HYDROGEN EFFECTS ON EXOTIC MATERIAL DEVICES

Version 1.1

## INTRODUCTION:

The effects of residual Hydrogen (H2) on GaAs pHEMT devices and other exotic materials in hermetically sealed packages are well documented by the GaAs MMIC community. This application note is intended to serve as an overview of this effect and to direct the reader to further technical resources that discuss the phenomenon in detail and provide guidance on how to mitigate this phenomenon.

### Technical Review

Many untreated hermetic microcircuit packages and packaged lids have been found to outgas Hydrogen over time. The Hydrogen typically comes from either the package base materials or the metal plated finish or finishes. Hydrogen is known to react with Platinum (Pt) and Palladium (Pd) metals used in the pHEMT Field Effect Transistor (FET) gate metal stack-up and other exotic material device chemistry. The Hydrogen reaction can result in degradation of the transistor's performance over time. The degree of reaction between the Hydrogen and Pt is dependent on the concentration of Hydrogen (Partial Pressure), the amount of exposed Pt or Pd in the gate and the ambient temperature.

Analog Devices' MMIC designs use a variety of processes, some of which use Pt or Pd in the gate structure and are therefore affected by the presence of Hydrogen.

If your design utilizes a known hydrogen sensitive device in a semi-hermetic or hermetic package, please consider using a hydrogen getter.

### Mitigating the Effects of Hydrogen

There are many industry studies and papers that propose solutions for mitigating the effects of Hydrogen on sensitive GaAs MMIC devices. Some solutions that have been proposed and are successfully used in the industry include:

1. Elimination of the source of Hydrogen through careful material selection and processing. A good reference for this solution can be found at: http://www.ors-labs.com/pdf/Hydrogen2.pdf
2. Absorption of the free Hydrogen within the package cavity with Hydrogen getter materials.
3. Allowing the Hydrogen to escape from the package cavity by either using non-hermetic packages or "hermetic packages" with provisions that allow the internal atmosphere to escape from the package.

### Questions

If you have any questions or concerns about ADI products and hydrogen sensitivity, please Contact ADI.

### Useful References


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