New Purifier Material for Removal of Trace Organic Contaminants from Process Gases

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Matheson Tri-Gas, ATC Longmont
Trace hydrocarbon impurities - from where?

• source gases (cylinders, raw material)
• system component outgassing
  (Pump Oil, MFC’s, valves, lines..)

Why are they problematic?

decreased device performance in Si processes
  • poly-Si, Si₃N₄, well formation, field oxides,
    EPI-Si, Al deposition, ...
  • carbon as dopant?
Current Purifier Technologies

organometallic resins
  - HC’s not removed
functionalized inorganic supports
  - HC’s not removed
oxide based inorganic materials
  - NM-HC’s removed
heated Getters (e.g. Zr/Fe/V-based)
  - All HC’s removed
n-Hexane Removal Efficiency
(N₂ matrix, APIMS)

Purifier bypass, ~5 ppb challenge
Flow through purifier

~5 ppb challenge
0.6 ppb challenge
~5 ppb challenge
6300 ppb (6.3 ppm) challenge
630 ppb challenge
49 ppb challenge

Time [hrs]

n-hexane [ppb]
n-Hexane Removal Capacity

(86 ppm Challenge, N₂ matrix, APIMS)

Capacity ~ 15 l/l
Aromatics Removal from Contaminated N\textsubscript{2} Stream

APIMS Response [cps]

HC purifier

m/z=106

m/z=78

Mark Raynor, Matheson Tri-Gas - Slide 6
APIMS Spectra Comparison:
New HC Purifier vs. Heated Getter

low level HC contaminated N₂

heated getter

hydrocarbon purifier

heated getter - hydrocarbon purifier

80 100 120 140 160
m/z
Ethylbenzene Removal from NH₃ (FTIR)

- Ethylbenzene concentration in ppm vs. time in hours.
- D/L ~50 ppb
- Through hydrocarbon purifier
- Bypass
n-Butane Removal from NH₃ (FTIR)

D/L ~100 ppb through hydrocarbon purifier

bypass

n-butane [ppm]

0 0.2 0.4 0.6 0.8 1

time [hrs]
Summary

• new inorganic NM-hydrocarbon purifier
• inert and reactive process gases
• high surface area - high capacity (15 l/l C<sub>6</sub>)
• operates at room temperature
• stand-alone or combined w/ other materials
• high efficiency verified for C<sub>4</sub> and C<sub>6</sub>