Micro-differential thermal analysis detection of adsorbed explosive molecules using microfabricated bridges

Although micromechanical sensors enable chemical vapor sensing with unprecedented sensitivity using variations in mass and stress, obtaining chemical selectivity using the micromechanical response still remains as a crucial challenge. Chemoselectivity in vapor detection using immobilized selective layers that rely on weak chemical interactions provides only partial selectivity. Here we show that the very low thermal mass of micromechanical sensors can be used to produce unique responses that can be used for achieving chemical selectivity without losing sensitivity or reversibility. We demonstrate that this method is capable of differentiating explosive vapors from nonexplosives and is additionally capable of differentiating individual explosive vapors such as trinitrotoluene, pentaerythritol tetranitrate, and cyclotrimethylenetetranitromine. This method, based on a microfabricated bridge with a programmable heating rate, produces unique and reproducible thermal response patterns within 50 ms that are characteristic to classes of adsorbed explosive molecules. We demonstrate that this micro-differential thermal analysis technique can selectively detect explosives, providing a method for fast direct detection with a limit of detection of 600x10\(^{-12}\) g. ©2009 American Institute of Physics

General information
State: Published
Organisations: Nanoprobes Group, NanoSystemsEngineering Section, Department of Micro- and Nanotechnology, Dynamic NEMS Group
Pages: 035102
Publication date: 2009
Peer-reviewed: Yes

Publication information
Journal: Review of Scientific Instruments
Volume: 80
Issue number: 3
ISSN (Print): 0034-6748
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.32 SJR 0.585 SNIP 0.858
Web of Science (2017): Impact factor 1.428
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.2 SJR 0.703 SNIP 1.048
Web of Science (2016): Impact factor 1.515
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.11 SJR 0.686 SNIP 0.908
Web of Science (2015): Impact factor 1.336
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.45 SJR 0.972 SNIP 1.261
Web of Science (2014): Impact factor 1.614
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.28 SJR 0.9 SNIP 1.099
Web of Science (2013): Impact factor 1.584
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.45 SJR 1.017 SNIP 1.277
Web of Science (2012): Impact factor 1.602
ISI indexed (2012): ISI indexed yes