

Report
On
Thermal Barrier Coatings
(Publication Year - 2004 to 2009)

SciTech Patent Art

Hyderabad

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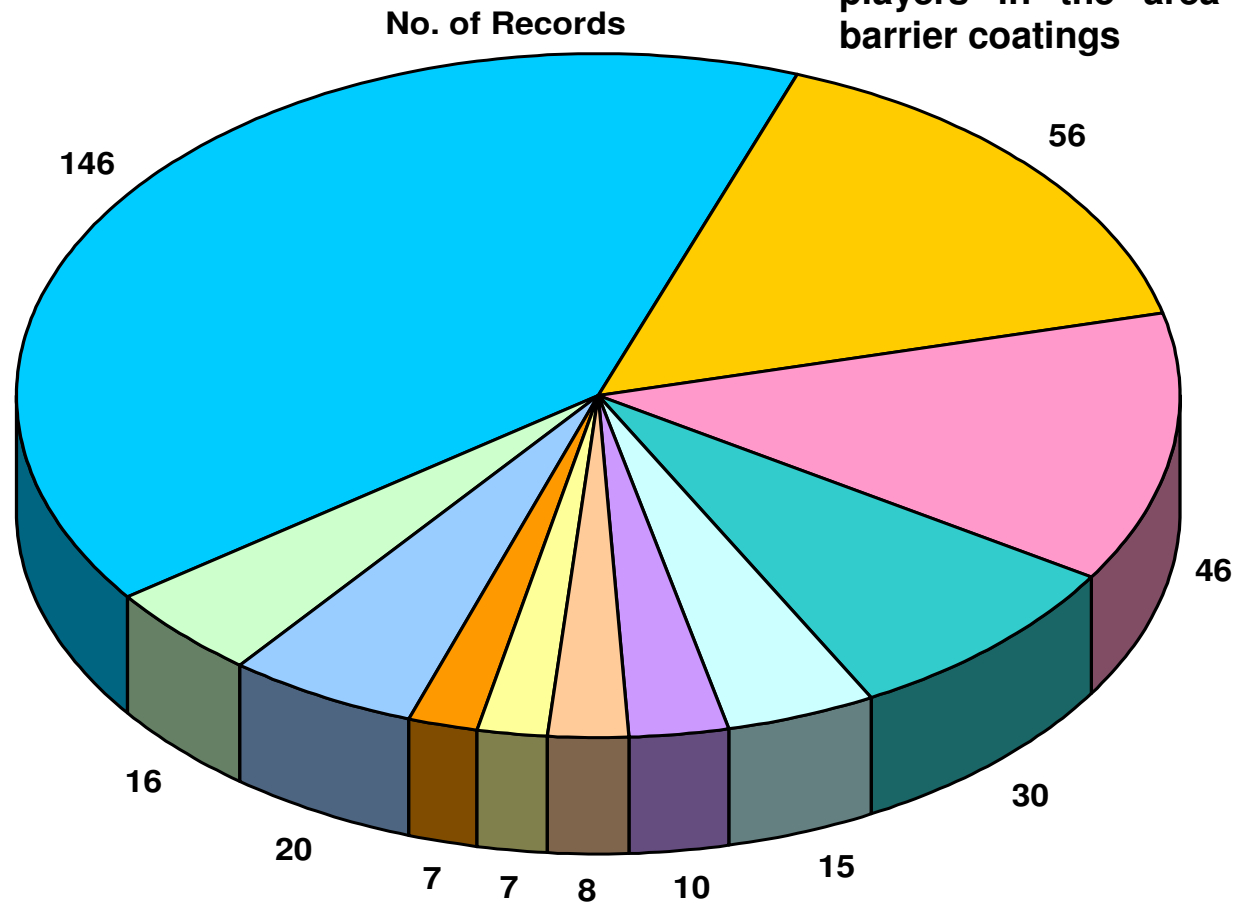
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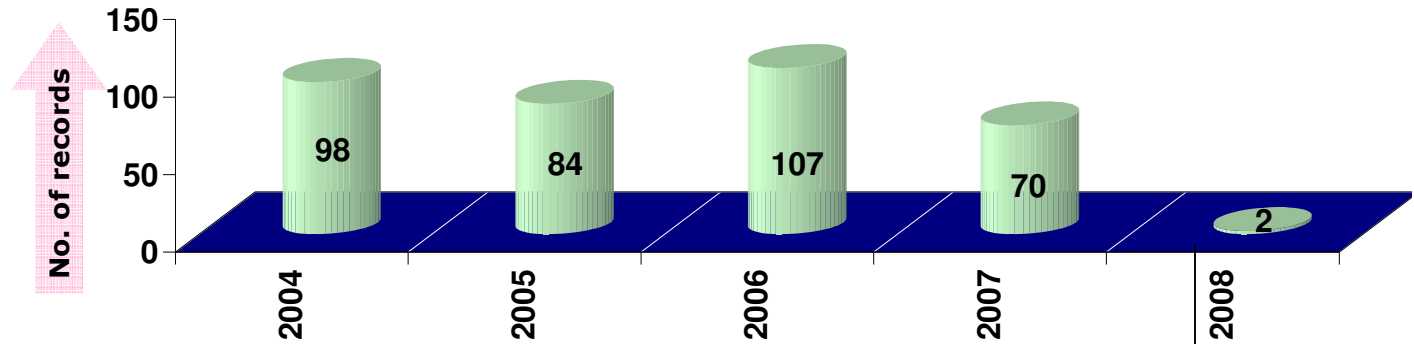
Thermal Barrier Coatings – Assignee-wise distribution

General Electric, Siemens AG and United Technologies are the lead players in the area of Thermal barrier coatings



- | | | |
|-----------------------|----------------------------------|---------------------------------|
| General Electric | Siemens AG | United Technologies Corporation |
| Hitachi Limited | Honeywell International | Mitsubishi Heavy Industries |
| MTU Aeroengines | Mitsubishi Materials Corporation | Academic Institutes |
| Independent Inventors | Other Assignees | |

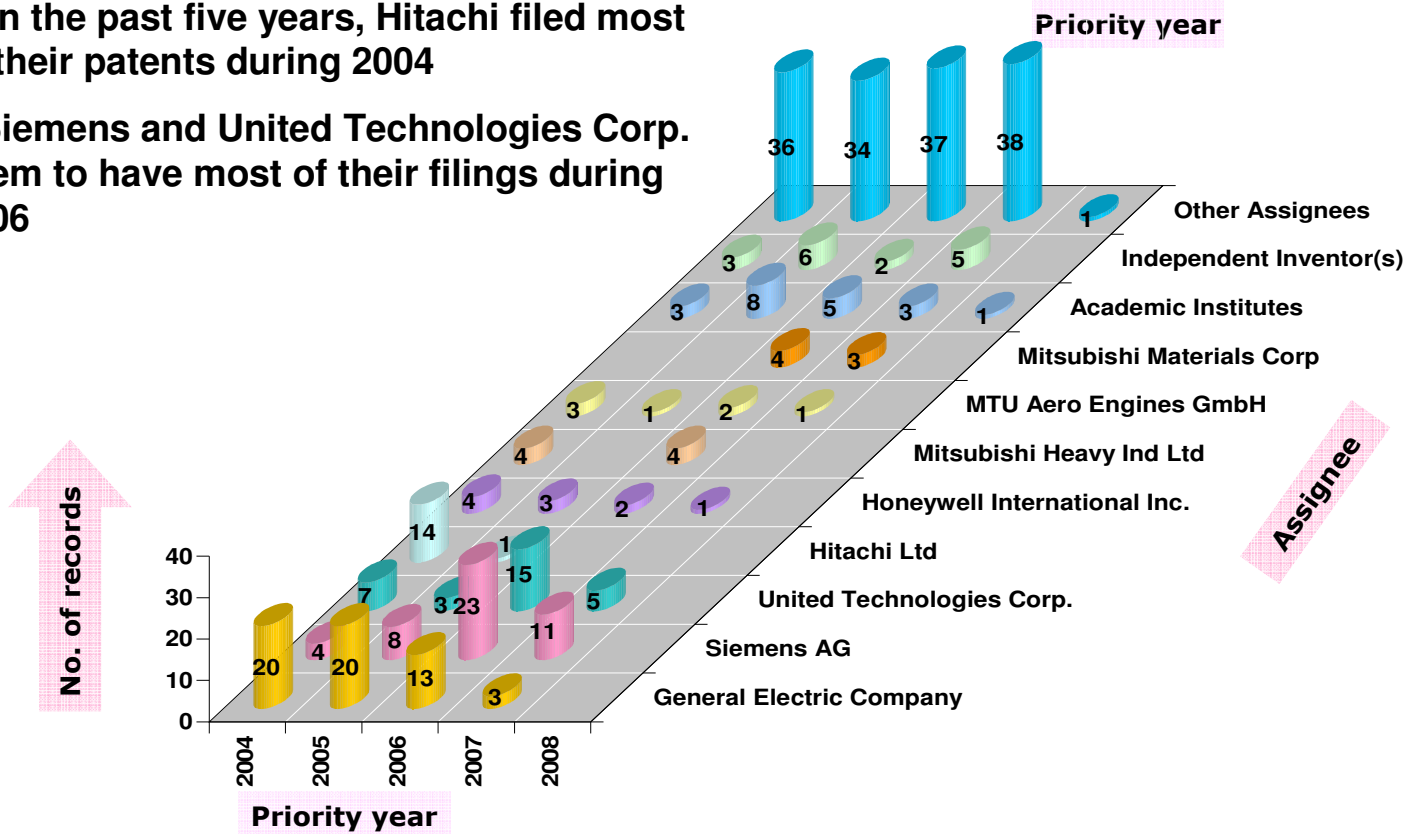
Thermal Barrier Coatings – Filing trends (based on Priority year)



➤ In the past five years, Hitachi filed most of their patents during 2004

➤ Siemens and United Technologies Corp. seem to have most of their filings during 2006

↓ Patents yet to be published



Thermal Barrier Coatings - Focus of the Top patent filers

Assignee	Focus
GENERAL ELECTRIC	Reduction of SRZ, Powder coating and Cathodic arc deposition process, ZrO ₂ -HfO ₂ , Carbide-nitride, RE silicate, Resistant Rhodium aluminide and bilayered coatings (for hostile environments), NiAl overlay and Silicide containing bond coat layers, Modulated columnar micro structure, EBC over TBC, Compound with rhombohedral phase, Temperature dependent transparency and Cooling holes
SIEMENS AG	CoNiCrAlY or NiCoCrAlY type bond coatings, Gradient in functional characteristics, Pyrochlore phase and secondary oxide for coating, Luminophoric layer for thermal insulation, Bi-layered metallic protective, Anti-corrosive layer coatings, Improvements in spallation & CTE
UNITED TECHNOLOGIES CORP.	HfO ₂ , Molten silicate Y-PSZ and Segmented GdO ₂ -ZrO ₂ coatings, Electrochemical impedance spectroscopy, Reduction in CTE, Relief of fatigue related to sand & dust, TGO layers, Erosion barriers, Cracked structures with diffusional porosity, Heat treatment with thermographic fluorescent agent
HITACHI LIMITED	Resistance to erosion, corrosion, wear and thermal shock resistance, Catalytically reactive coating, Co-deposition of Al & Cr, Heat insulating and adhesion promoting layer with improved fracture toughness, Removal of TBC
HONEYWELL INTERNATIONAL	Atomic Layer Deposition (ALD) of bond coats, Coating with high resistance to corrosion, Oxidation and sulfidation, EBPVD made TBC with columnar grain micro structure and heat treatment of alumina layers

Thermal barrier Coatings - Citation Velocity

Document ID	Assignee	Title	Year Issued	Cited by self	Cited by Others	Avg. Cites by Year
EP1806435	General Electric	Layered thermal barrier coatings containing lanthanide series oxides for improved resistance to CMAS degradation	2007	1	Siemens AG (4) Rolls-Royce (1)	2.0
EP1657536	Siemens	Device comprising at least one luminescent thermal barrier coating on a substrate	2006	4	Mitsubishi Heavy Ind (1)	1.6
EP1588992	General Electric	Mixed metal oxide ceramic compositions for reduced conductivity thermal barrier coatings	2005	2	MTU Aeroengines (1) United Tech (1) Sulzer Metco (1)	1.3
US20050235493	Siemens Westing House	In-frame repair of gas turbine components	2005	5	Ford-Werke GmbH (1) United Tech (1) Honeywell (1)	1.3
EP1674663	Mitsubishi Heavy Ind	Thermal barrier coating material, thermal barrier member, and member coated with thermal barrier and method for manufacturing the same	2006	0	Siemens AG (3)	1.0
EP1793011	General Electric	Process for forming thermal barrier coating resistant to infiltration	2007	0	Siemens AG (2)	1.0

Thermal Barrier Coatings – Collaborations

Collaborations	No. of records	Focus of the patent
Sumitomo Metal Ind. Ltd; Sango Co Ltd	1	Ferritic stainless steel sheet for an automotive exhaust gas system having superior heat resistance and superior seizure resistance during press-forming
Japan Fine Ceramics Center; Chibu Electric Power Co. Inc	2	Imparting excellent oxidation resistance and Surface-treated titanium material
Petroleum Energy Center; Nippon Mining Holdings Inc	1	A metal structural body having a coating with both heat and corrosion resistance

Thermal barrier Coatings – Academic Institutes

Academic Institutes	No. of Records	Focus
University Beijing Aeronautics	5	Thermal barrier coatings with high thermal stability, TBC suitable for nickel-base high temperature alloy, EBPVD to deposit multi-holes branch ceramic layer, Lamellar heat-proof smear layer and ceramic layer material
University Bei Hang	2	Chromic acid lanthanum ceramic material with high thermal stability and Columnar crystal coating
University Northeastern	2	Porous metallic medium burner which burns the gas with low calorificity; Metallic-ceramic porous medium gas fuel burner
Kagoshima University	1	A composite material with desirable characteristics of carbon and metallic materials
Tohoku University	1	Production of a heat shield coating member resistant even at high temperature for a long time

Thermal barrier Coatings – Recent published literature

- **EB-PVD Y_2O_3 - and CeO_2/Y_2O_3 -stabilized zirconia thermal barrier coatings - crystal habit and phase composition**
- **Effect of thermal aging on the erosion resistance of air plasma sprayed zirconia thermal barrier coating**
- **Estimating the fracture resistance of functionally graded thermal barrier coatings from thermal shock tests**
- **Thermal modeling of various thermal barrier coatings in a high heat flux rocket engine**
- **Stress distributions in plasma-sprayed thermal barrier coatings as a function of interface roughness and oxide scale thickness**
- **Acoustic emission source analysis of plasma sprayed thermal barrier coatings during four-point bend tests**
- **Oxygen transport by gas permeation through the zirconia layer in plasma sprayed thermal barrier coatings**
- **Thermal cycling resistance of modified thick thermal barrier coatings**
- **Characterization of thermal barrier coatings with a gradient in porosity**

Thermal barrier Coatings – Some of the products incorporating TBC

- Turbine blades
- Cutting tool inserts
- Aero engine parts
- Gas turbine parts such as combustion liners, shroud, nozzles or blades
- IC engine parts
- Rocket nozzles and valve bodies
- Damper pin for turbine bucket