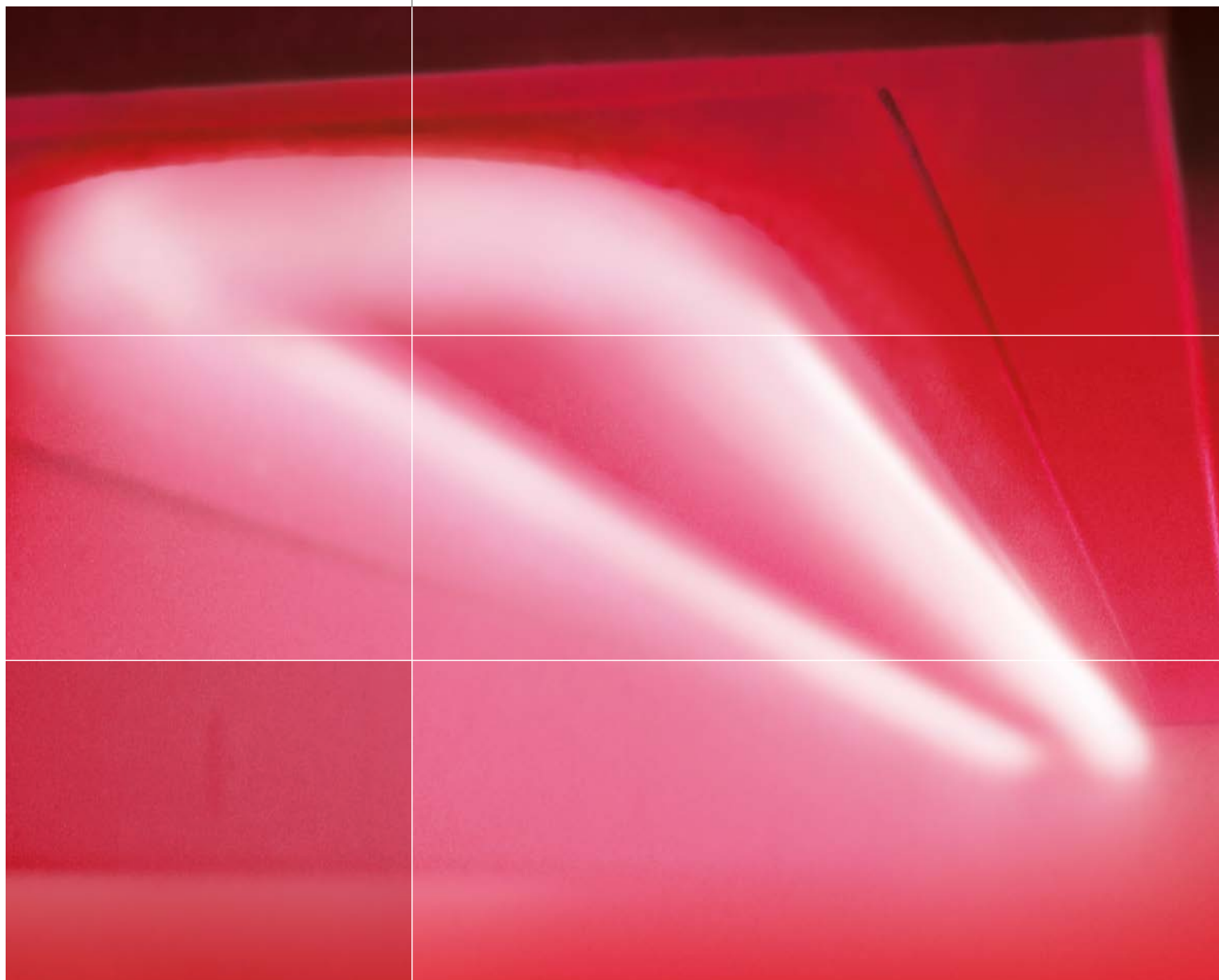




# \_COATING MATERIALS



\_GfE is a leading manufacturer of sputter targets, arc cathodes and evaporation materials used for PVD thin film technology worldwide.

As part of the AMG Group, GfE offers a wide range of high-quality products that meet the highest requirements set by the PVD thin film industry.

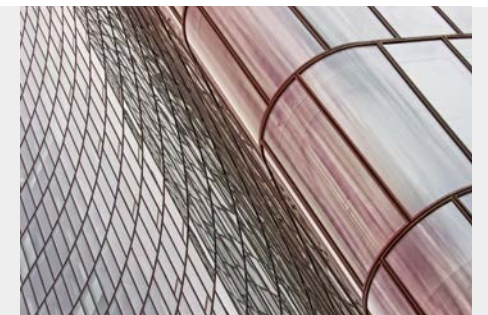


## COATING MATERIALS FOR PVD THIN FILM TECHNOLOGY



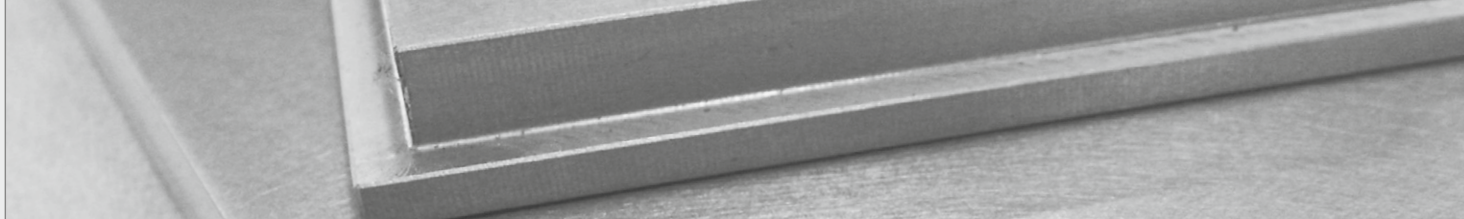
\_PVD Coating is one of the most environmentally friendly coating technologies available. GfE addresses environmental concerns during manufacturing through environmentally friendly and energy-efficient production technologies and product recycling. Our product development is focused on customer requirements and provides effective solutions based on over 25 years of experience.

Continued improvement of standard products, along with research and development of new products is key in GfE's ability to support the industry's increasing requirements, while also working to reduce production costs.



The „Stifterverband für die Deutsche Wissenschaft“ honored GfE's special commitment to research and development with the award „Innovative Through Research“.





## LARGE AREA COATINGS

GfE is very conscious of the growing importance of safeguarding our health and environment, and we are excited to do our part in that continued effort. Our products are widely used for thin film (PVD) coatings on glass as well as flexible substrates with “green” and “safe” results.

### Typical applications include:

- Architectural glass (low-E, solar control)
- Electrochromic windows
- Automotive mirrors and screens
- Security foils
- Hologram foils

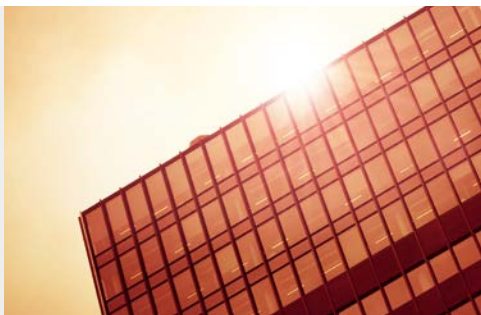
GfE’s products are available as rotatable and planar targets. Chemical composition, physical properties and size distribution information is available on our website and upon request.

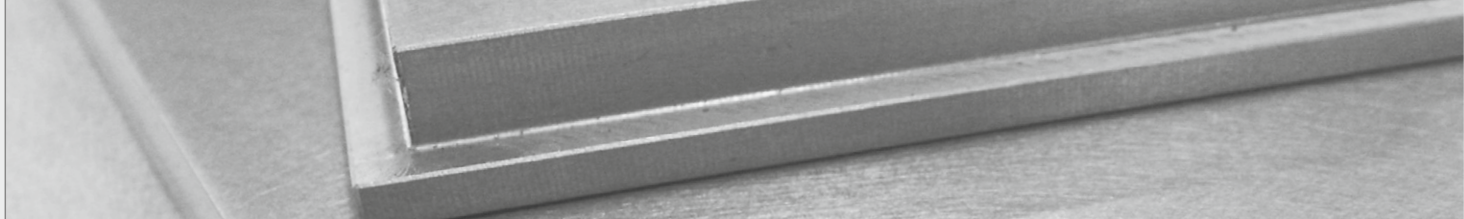
### Main products – planar targets:

- CROMA
- Chromium
- Indium Tin Oxide (I.T.O.)
- Nickel Chromium
- Niobium
- Niobium Oxide
- Silver
- Titanium
- Titanium Oxide (TIRU®)
- Zinc Oxide/Aluminum Oxide (AZOY®)

### Main products – rotatable targets:

- Aluminum
- Chromium
- Nickel Chromium
- Niobium Oxide
- Silicon pure
- Silicon Aluminum
- Silver
- Tin
- Titanium
- Titanium Oxide (TIRU®)
- Zinc
- Zinc Aluminum
- Zinc Oxide/Aluminum Oxide (AZOY®)
- Zinc Tin
- Zirconium





## SOLAR & PHOTOVOLTAIC

GfE is a leading global supplier offering a wide range of coating materials in the form of highly developed rotatable and planar targets. With ever-increasing global energy demands and concerns for the ability to serve those needs, GfE is proud to offer materials that are at the forefront of the movement towards renewable energy systems and solar applications.

**Our materials are used in the following layer stacks:**

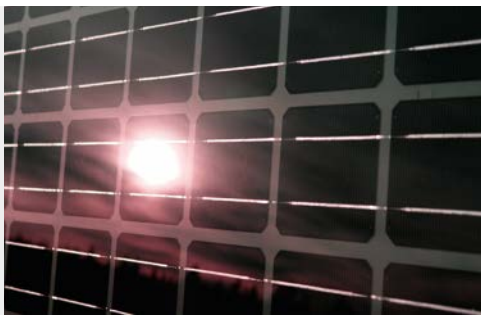
- Copper Indium Gallium (CIGS)
- a-Si
- a-Si/ $\mu$ c-Si
- CdTe
- Si wafer based cells
- Thermal solar

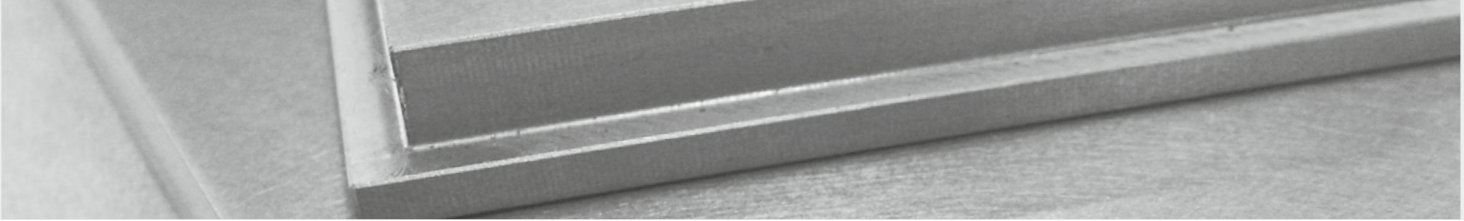
**Main products – planar targets:**

- CROMA
- Chromium
- Copper Indium Gallium (CIG)
- Indium Tin Oxide (I.T.O.)
- Molybdenum
- Nickel Vanadium
- Silicon
- Silver
- Zinc Oxide
- Zinc Oxide/Aluminum Oxide (AZOY®)
- Zinc Oxide/Gallium Oxide
- Zinc Oxide/Magnesium Oxide

**Main products – rotatable targets:**

- Aluminum
- Chromium
- Copper
- Molybdenum
- Nickel Vanadium
- Silicon pure & high purity
- Silver
- Tin
- Zinc Oxide
- Zinc Oxide/Aluminum Oxide (AZOY®)
- Zinc Oxide/Gallium Oxide





## WEAR & DECORATIVES

\_GfE's coating materials are used to produce wear resistant and protective hardcoatings which are utilized in various industries. Our materials are used in the following areas:

- Tooling industry
- Mould and die industry
- Machinery industry
- Medical industry
- Automotive component industry
- Aerospace component industry
- Decorative industry

\_GfE materials are available as arc cathodes, sputtering targets, granules or powders. Chemical compositions, purity and sizes are available on our website and upon request.

### Main products for wear resistant and decorative applications:

- Aluminum Chromium
- Aluminum Chromium Silicon
- Aluminum Titanium
- Aluminum Titanium Chromium
- Aluminum Titanium Silicon
- Graphite
- Chromium
- Molybdenum Disulfide
- Niobium
- Nickel Chromium
- Titanium
- Titanium Aluminum
- Titanium Silicon
- Vanadium
- Zirconium
- Other tailor-made coating materials on request







## OPTICAL INDUSTRY

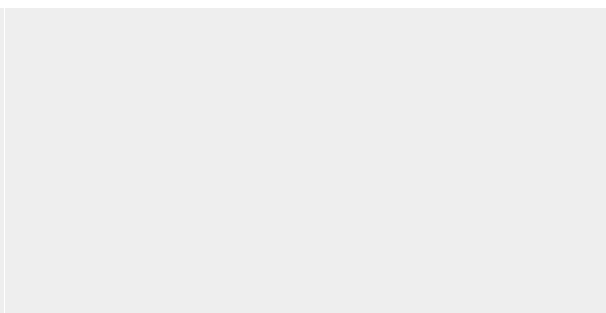
\_GfE is a leading manufacturer of highly refractive oxides for the use in the fields of glasses, precision optics and fiber optics. As continued advancements are made in the fields of telecommunications, ophthalmics, medical and aerospace among others, GfE's materials will play a large role in forging the way. The purity, homogeneity, microstructure and density of the material are adjusted to meet specific customer requirements.

### Our materials are used in the following industries:

- Ophthalmics
- Precision Optics
- DWDM

### Main products:

- |                                 |                                     |
|---------------------------------|-------------------------------------|
| □ Aluminum Oxide                | □ Praseodymium Oxide/Aluminum Oxide |
| □ Cerium Oxide                  | □ Praseodymium Oxide/Titanium Oxide |
| □ Chromium                      | □ Silicon Oxide                     |
| □ Hafnium                       | □ Silicon Oxide/Chromium            |
| □ Hafnium Oxide                 | □ Silicon Oxide/Molybdenum          |
| □ Hafnium Oxide/Aluminum Oxide  | □ Tantalum Oxide                    |
| □ Hafnium Oxide/Yttrium Oxide   | □ Tantalum Oxide/Niobium Oxide      |
| □ Hafnium Oxide/Zirconium Oxide | □ Titanium Oxide (TIRU®)            |
| □ Magnesium Oxide               | □ Yttrium Oxide                     |
| □ Magnesiumfluoride/Chromium    | □ Zirconium Oxide                   |
| □ Niobium                       | □ Zirconium Oxide/Titanium Oxide    |
| □ Niobium Oxide                 | □ Zirconium Oxide/Yttrium Oxide     |
| □ Praseodymium Oxide            |                                     |





## DISPLAY

\_As we move from the analog age into the High Definition age, we are in a prime position to service this shift on the front end. GfE's highly developed sputtering targets are used in the display industry in the following areas:

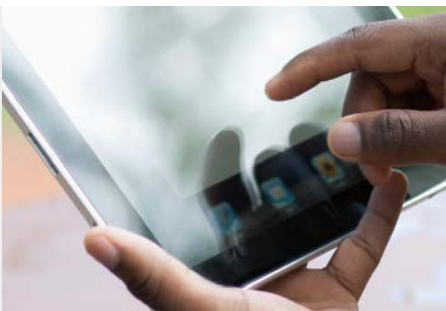
- Touch panels
- PDP filters
- LCD (TFT, color filters)
- LED

### Main products – planar targets:

- Aluminum
- Chromium
- Copper
- Molybdenum
- Niobium Oxide
- Silicon
- Titanium Oxide (TIRU®)
- Zinc Oxide/Aluminum Oxide (AZOY®)

### Main products – rotatable targets:

- Aluminum
- Copper
- Molybdenum
- Molybdenum Niobium
- Niobium Oxide
- Si pure & high purity
- Titanium Oxide (TIRU®)
- Zinc Oxide/Aluminum Oxide (AZOY®)



## SCIENTIFIC TECHNICAL SERVICES CHEMICAL ANALYSIS, METALLURGICAL DIAGNOSTIC

\_Your materials will be tested in our accredited laboratories. With the most modern technology we can determine composition, characteristics, structures and microstructure of your materials.

### Our capabilities are:

- Qualitative and quantitative chemical analysis
- Special analysis:
  - \_wet chemical analysis with AAS and ICP
  - \_nonmetals with automatic analytical systems
- Standard methods: XRF, ICP, Leco (C, N, H, O)
- Electron probe microanalysis (EPMA) with WDX and EDX
- Scanning electron microscope (SEM) with EDX
- Materials testing and official material reports
- Material dependability tests



WHAT WE OFFER IN QUALITY



- Certification according to  
ISO 9001; EN 9100; ISO 14001 and BS OHSAS 18001
- Integrated Management System (IMS)
- Documented quality control process
- Quality assurance laboratory
- Regular quality audits by GfE-customers
- Certification according to GTS-QM-rule: GTSPA 00
- Accredited laboratory: ISO 17025
- Chemical analytics
- Material diagnostics

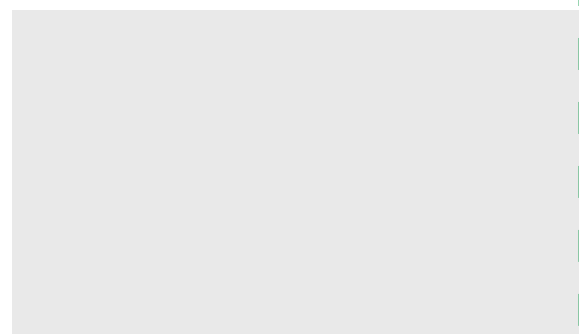




## WHO WE ARE

With more than 100 years of know-how GfE's R&D department is continuously developing new materials tailor-made to our customers' requirements. Our worldwide sales channels enable GfE to individually serve and support our customers.

GfE is a subsidiary of AMG Advanced Metallurgical Group N.V. Netherlands, a global leader in the production of specialty metals and metallurgical vacuum furnace systems.



### AMG TITANIUM ALLOYS & COATINGS

GfE Metalle und Materialien GmbH  
Höfener Straße 45  
90431 Nürnberg  
Germany

Phone: +49 (0) 911 9315-92  
Fax: +49 (0) 911 9315-491  
E-mail: [coatings@gfe.com](mailto:coatings@gfe.com)  
Website: [www.gfe.com](http://www.gfe.com)

GfE Fremat GmbH  
Gewerbegebiet Süd 20  
09618 Brand-Erbisdorf  
Germany

Phone: +49 (0) 37322 472-500  
Fax: +49 (0) 37322 472-502  
E-mail: [fremat@gfe.com](mailto:fremat@gfe.com)

