

**News release**

**4 March 2020**

**ZIA identifies principal areas of research relating to zircon, zirconium and zirconia**

The Zircon Industry Association annually identifies the most popular areas of research relating to zircon and its downstream derivatives.

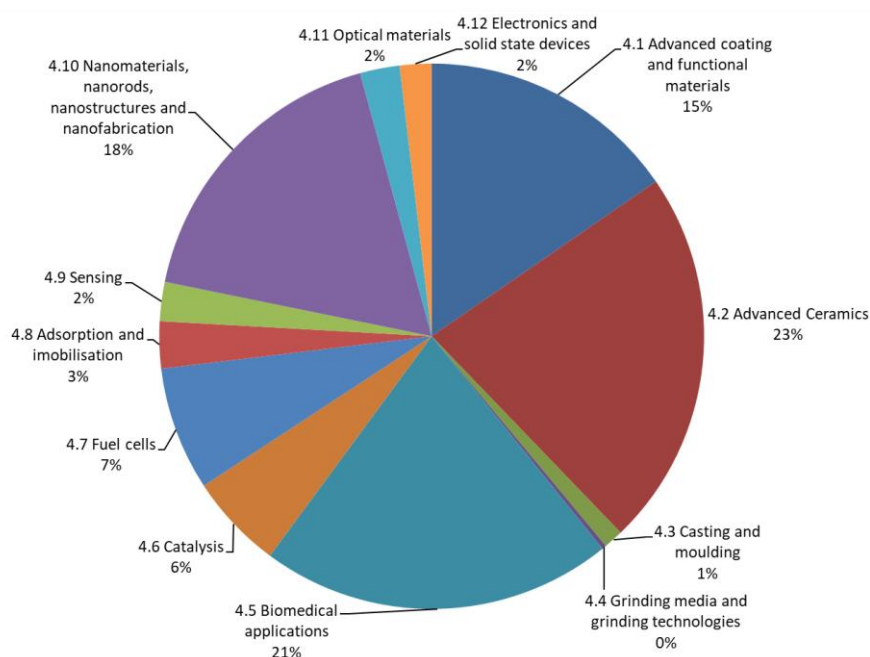
Following a review of over 3,450 peer-reviewed papers published in 2018, it has been possible to identify these areas of research and make an informed assumption as to the likely potential for industrial application.

Specialists at Centro Ceramico, Bologna (Italy) carried out the literature search and categorised the papers into subject areas. Areas with more than 30 publications were considered to have a high potential market demand, indicating that the interest of the scientific community is high and, therefore, the topic might merit exploitation at industrial level.

The most popular fields of zircon-related research were as follows:

1. Advanced ceramics
2. Biomedical applications
3. Nanomaterials, nanorods, nanostructures and nanofabrication
4. Advanced coating and functional materials
5. Fuel cells
6. Catalysis

The 3,450 papers in 2018 fell into the following areas of research:





### Further details on the results

The most popular field of research in 2018 was **advanced ceramics**. Of the 773 papers in this field, 30% of them focused on industrial applications. These included:

- Zirconia ceramics and composites (PZT and doped PZT) with piezoelectric and dielectrics properties, ultra-high temperature and corrosion zirconia based ceramics
- Zirconia and zirconia composites for dental implants and dental parts (crowns bridges, veneers, screws, abutments)

These have potential applications in the automotive, aerospace, military, biomedical, electronics and dental fields.

The **biomedical** field was the second popular area of research. Of the 721 papers in this field, 45% of them focused on industrial applications. Topics included:

- Zirconium in metal alloys (e.g. titanium based) for biomedical applications
- $ZrO_2$  and  $ZrO_2$  composites with treated or functionalised surface for better osteointegration or adhesion and/or bioactivity
- $ZrO_2$  and  $ZrO_2$  composites for dental crowns, bridges, implants and veneers
- Positron Emission Tomography (PET) imaging radiolabelled Zr-89.

These have applications within the fields of orthopaedic implants, dental applications, bioimaging and tumours diagnosis.

The third popular area of research was within the field of **nanomaterials, nanorods, nanostructures and nanofabrication**. 55% of the 606 papers in this area were focused on:

- Industrial applications including zirconium oxide doped carbon nanotubes and zirconium nanotubes
- $ZrO_2$  and  $ZrO_2$  composites thin films with magnetic, ferroelectric and dielectric properties
- $ZrO_2$  composites thin films (e.g.  $ZrO_2$ - $TiO_2$  and nanocomposites for photocatalysis)

These have potential applications in the fields of catalysis, electronics, optical applications, fuel cells, biomedical applications and telecommunications systems.

The fourth popular area of research was in the field of **advanced coating and functional materials**. Of the 531 papers in this area, 70% focused on industrial applications including:

- Zr compounds and  $ZrO_2$  composites protective coating against heat, wear, abrasion, corrosion for ceramic, metals, alloys and glasses, thermal barrier coating (TBC)
- Zr and  $ZrO_2$  composites coating produced by new techniques such as plasma spray, pulse electrodeposition, aerosol gas deposition.

These have potential applications in the fields of aerospace, automotive, power plants, petroleum industries, chemical processing and possible biomedical applications.



The area of **fuel cells** also attracted considerable research. 35% of the 253 papers focused on industrial applications including Zr compounds,  $ZrO_2$  and  $ZrO_2$  composites as electrolyte for solid oxide fuel cells which has potential applications in clean, efficient energy generation, renewable fuel production and electricity storage. **Catalysis** was also an area that attracted substantial research with 195 papers published, 65% of which focused on industrial applications. These included research on Zr compounds,  $ZrO_2$  and  $ZrO_2$  composites as catalyst, and catalyst support for gas catalysis e.g. CO oxidations, methane decomposition, dehydration and dehydrogenation reactions, ethanol conversion,  $SO_2$  reduction,  $H_2$  production.

Other areas of research in 2018 included **adsorption and immobilisation, sensing, optical materials, electronics and solid devices as well as casting and moulding.**

The three ZIA literature reviews conducted between 2016 and 2018 now offer an opportunity to identify potential research trends. During this three year period, the areas of advanced ceramics and biomedical research have increased based on the number of peer-reviewed publications. .

ZIA Executive Director, Dr Keven Harlow, commented:

“Zircon and its derivatives play an essential role in today’s modern world in a vast array of applications from industrial uses to everyday products. This annual review of literature gives an insight into the potential for zircon and its derivatives to play an even greater role in future across a number of sectors.”

#### **Notes to editors**

1. Further graphic representation of the literature review is available on the ZIA website [Publications Review](#) page . Copies of the ZIA literature reviews are available to members.
2. The Zircon Industry Association (ZIA) is an independent industry association. Its mission is to represent and support the interests of the zircon, zirconia and zirconium value chains, from zircon sand production, to a wide range of downstream products including zircon flour, opacifiers, refractory materials, friction materials, fused zirconia and zirconium chemicals, metal and alloys. Its members currently represent some 80% of the globally-produced zircon tonnage.
3. ZIA operates a strict Code of Conduct and Antitrust Policy.