Advanced materials have strategic importance for economic growth

Advanced materials are a group of materials that have strategic importance for economic growth, industrial competitiveness and capable of addressing the grand societal challenges. They are designed to have superior characteristics (e.g., strength, weight, conductivity) or functionality. Advanced materials "make the difference" for many applications and can used everywhere

The EU Framework Programme for Research and Innovation *Horizon 2020* supports innovative solutions for advanced materials for the following fields:

- **Energy** (including energy generation, storage, and transmission);
- **Transport** (in particular electrochemical storage for e-mobility and lightweight materials);
- **Environment** (including advanced bio-based or bio-degradable materials);
- **Buildings** (including materials for structural elements, finishes and envelope, glazed components and lighting, and insulation);
- **Healthcare** (in particular advanced biomaterials for more effective therapies and diagnostics for important diseases);
- **Electronics** (including graphene and materials for power electronics and data storage);
- **Textiles** (including novel functional materials for non-clothing applications);
- **Chemistry** (bio-based chemicals and catalysis);
- **Resource efficiency** (substitution of critical raw materials).

Examples of material solutions that could have a breakthrough potential

- **Nanomaterials** stand out in terms of their high rate of improvement, broad potential applicability, and long-term potential to drive massive economic impact. At nanoscale (less than 100 nanometers), ordinary substances take on new properties—greater reactivity, unusual electrical properties, enormous strength per unit of weight—that can enable new types of medicine, super-slick coatings, stronger composites, and other improvements. Advanced nanomaterials such as graphene and carbon nanotubes could drive particularly significant impact.
- **"Green" materials** attempt to solve environmental issues. Low-CO_2 concrete, for example, could reduce emissions from concrete production, which are estimated to account for 5 percent of total CO_2 emissions. Adding advanced materials reduces the amount of fuel required to burn and grind the ingredients of concrete and reduce the need to de-carbonate limestone within the kiln
- **Self-healing materials** take their inspiration from biological systems that can self-organize and self-repair. Self-healing materials would reduce the need for costly maintenance by healing themselves when damage occurs. One example is self-healing concrete, which would include ingredients that are automatically released or that expand to fill cracks when they appear
- **Piezoelectric materials** that turn pressure into electricity are not new, but researchers continue to find new potential applications, such as generating electrical energy from movement. Eventually, it could be possible to capture electricity from the movement of pedestrians to generate electricity or to incorporate piezoelectric materials into clothing to power mobile Internet devices
- **Memory metals** revert to a prior shape when heated to a specific temperature. These materials are being considered as a way of producing movement in light, inexpensive robots – using a charge to expand or contract the material, imitating muscle movement. Some versions of memory metals can even be "programmed" to take on multiple shapes at different temperatures
- **Advanced composites** could help build strong, lighter components for vehicles, including aircraft. In addition to next-generation nanocomposites, ongoing advances in composites made from carbon fiber and other materials could make it possible to substitute composites for materials such as aluminum in more applications. These advances include new ways of producing and binding carbon fiber, allowing for less expensive fabrication

SOURCE: McKinsey Global Institute *Disruptive technologies: Advances that will transform life, business, and the global economy,* May 2013