

Materials and manufacturing engineering

with Distinguished Professor Zhengyi Jiang

Talking points

Knowledge & Comprehension

1. What are two purposes of rolling in metalworking?
2. How are finite element analysis, computational fluid dynamics and molecular dynamics used in materials and manufacturing engineering?
3. Why would corrosion-resistant and self-lubricating materials be useful for building a submarine?

Application

4. What other applications can you think of for Zhengyi's different composite materials, in addition to those mentioned in the article?
5. Composite materials have been manufactured since the dawn of civilisation. What do you think some of the earliest composite materials might have been?

Analysis

6. Alloys (metals that contain more than one element, such as steel) are generally not considered composite materials. Why do you think this is?
7. What problems occurred during rolling reduction in the stainless steel manufacturing process? Why do you think Baosteel was interested in collaborating with Zhengyi to address these?

Evaluation

8. Zhengyi notes that "emerging technologies like 3D printing, intelligent manufacturing, and AI-driven process automation and optimisation" will significantly change the field of materials and manufacturing engineering. What do you think these changes will look like?
9. Why is collaboration between academia and industry so important in the field of materials and manufacturing engineering?

Activity

Choose one of Zhengyi's new composite materials or innovative manufacturing processes mentioned in the article. Make notes about:

- The real-world problem(s) it aims to address
- The engineering involved in creating the composite or improving the process
- How the outcome addresses the problem(s)
- Applications for the composite or process (from the article and your own ideas).

Imagine you are in Zhengyi's research team and are approaching a manufacturing company to ask them to fund your research so you can further improve your chosen composite or process. Design a presentation that convinces them to fund your work. In addition to the points mentioned above, focus on:

- Why the company should fund your research and how they will benefit
- How you will collaborate with the company and what their role in the development process will be
- Your expected outcomes of this research.

Your presentation should be engaging, so use graphics, images and concise text on any slides. Deliver your presentation to your classmates, who should take on the role of representatives from the manufacturing company, and answer any questions they might have. Can you convince them to fund your research?

Then, take on the role of a company representative and listen to your classmates' presentations.

More resources

- This article gives a history of composite materials from 7000 BCE to the modern day:

autodesk.com/design-make/articles/history-of-composite-materials

- This video provides an overview of different manufacturing processes, including techniques mentioned in Zhengyi's article: youtube.com/watch?v=Um_g8sQ_p3Y

- Learn more about the Australian Research Council Industrial Transformation Training Centre for Innovative Composites for the Future of Sustainable Mining Equipment: arc-innovative-composites-sustainable-mining.org.au