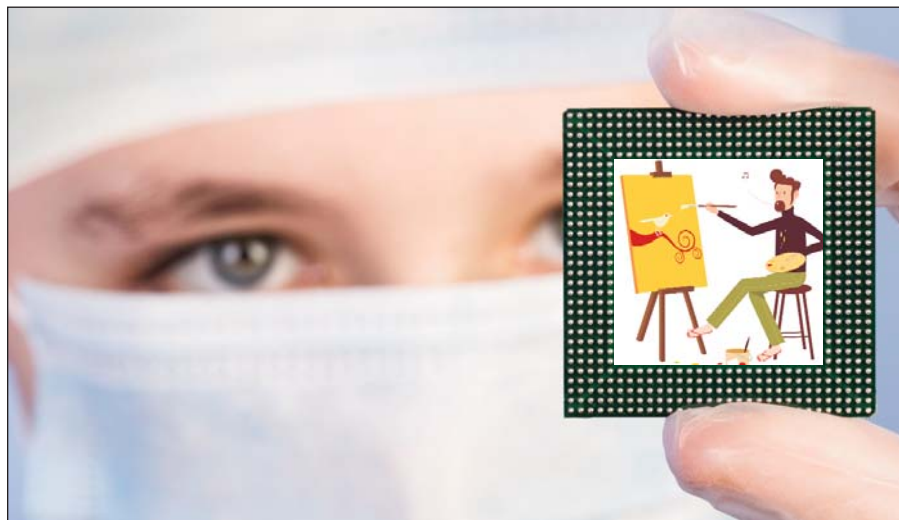


## Modern Materials



*Modern physics* began in about 1900, with the development of quantum mechanics and relativity, and was in full swing by the 1920s after the Bohr atom gained acceptance. I learned physics at school in the 1950s from a textbook written by my teacher and called *Modern Physics*. University syllabi still refer to *Modern Physics* in 2008. The term *modern* seems rather elastic and, surviving for more than a century, has surely lasted far too long for any cultural movement. Modernism in art only lasted from about 1890 to 1940, a mere 50 years. Materials research is, in many ways, newer than physics—so what might “modern materials” be? (Don’t get me wrong here: Materials are of course much older than physics, but the scientific approach to materials is not.)

The phrase “modern materials” has variously been applied by different writers either very generally to anything developed in the past 50 years, or more specifically to functional materials or smart materials or green materials, or advanced materials with improved properties or recently to nanostructured materials. By the way, I’m not sure how nanostructure can be considered “modern” when I was taught about GP [Guinier–Preston] zones in aluminum alloys in 1961, and it was 25-year-old stuff then.

Since “modern” does not work for us, it might be more interesting to borrow from the arts and think of materials research in terms of movements, each lasting about a decade. For example, the 1960s were a period during which we looked inward—to microstructure and point and lattice defects—and the main

targets of our study were metals. We did this in response to the availability of new scientific tools and ideas and in reaction to the empiricism of the first half of the 20th century. Materials researchers behaved either like Impressionist painters—using scientific insights as the painters used their improved understanding of color—or like the Pre-Raphaelites, seeking to go back and do a better job than their predecessors. The Pre-Bainite movement perhaps.

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In the 1970s, we started to look seriously at surfaces, again made possible by the development of new techniques (thank you, Kai Seigbahn, who died last year). Now we widened our scope to include polymers and amorphous metals. Perhaps the best analogy here is with the Art Deco movement which flourished in the 1920s and 1930s and which celebrated the use of a wider range of materials and surface finishes.

The 1980s saw two new passions in our

discipline—we started in earnest to grow materials atom-layer by atom-layer and we devised lots of composite materials, trying with great success to obtain properties which exceeded the sum of their individual parts. This was our Bauhaus period, characterized by its economic, geometric design and by its respect for materials.

The real world intruded heavily in the 1990s, when our attention turned to semiconductor materials driven by burgeoning sales of computers and consumer devices. We got much better at modelling and simulation (because experiments are expensive and slow) and we became acutely aware of the interface between biology, medicine, and materials. This was our Pop Art phase, which was originally marked by a fascination with popular culture reflecting the affluence of post-war society. It was most prominent in U.S. art but soon spread to Britain—this seems accurate enough for materials research, too. Perhaps here we see the start of Post-Modernism, characterized by a move away from the “highbrow” seriousness of Modernism. If society wants an MP3 player, let’s give it one. Post-modernism, as in the art world, is still with us.

And finally to the first decade of the 21st century, in which the dominant themes seem to be the engineering of the materials life cycle and its energy and carbon costs. The materials which grab the headlines are optical—whether polymers, nanoscale, or layered. They emit, transmit, or reject light. This is our Op Art phase, in which the Op originally stood for “optical”—albeit not using high tech but clever design; just try looking at a large Bridget Riley painting for more than 10 seconds.

So, over five decades we have developed through Pre-Raphaelite, Art Deco, Bauhaus, Pop Art, and Op Art movements. The odd thing is, and I hate to point this out, that the art community got there in each case about 40 years before we did. The Pre-Raphaelite 1920s align with our Pre-Bainite 1960s; the Art Deco ‘30s with our surface science ‘70s; down to the Op Art ‘60s and our millennial fascination with things optical.

What will be the materials research movement of the 2010s? I suggest we take a look at the art movements of the 1970s. Let me offer a few ideas to ponder: Post-Minimalism, Installation Art, Neo-Expressionism, Process Art. If I knew what they meant I might be able to help you, but I don’t so I must leave the crystal ball gazing to you, the post-modern reader.

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