Beautiful Chemistry

BY LAURA MILLSAPS

One thing Andreja Bakac knows about her 37 years as a chemist — it has been beautiful.

"There is a lot of beauty to chemistry, the kind that anyone can appreciate. You don't have to be a scientist to see it," she says.

"I love the colors. Inorganic compounds cover the entire spectrum, from sky blue to emerald green, purple, yellow and everything in between. Sometimes the hues are different at different concentrations of reagents or when observed from different angles. And crystals, tiny or large, can take breath-taking shapes and colors."

Bakac, a senior scientist for Ames Laboratory and adjunct professor in the Department of Chemistry at Iowa State University, was drawn to the beauty of chemistry in middle school. Though she enjoyed studying other subjects like physics, math, and literature, chemistry had special appeal.

As she gained knowledge in the science, attending the University of Zagreb and University of Leeds, it became clear that it also suited her personality.

"By nature I am not a patient person," Bakac says. "I can't wait to see results. Organic chemistry is typically slow, so that you set up an experiment and let it run for hours. In inorganic chemistry, especially the kind we do, reactions are finished in minutes, microseconds, nanoseconds. I like that."

Bakac has turned that beauty and speed into an entire career exploring and understanding the nature of chemical reactions.

Her research group studies ways to activate normally unreactive molecular oxygen (0_2) through the use of specially designed complexes of transition metals, such as iron or cobalt. The ultimate goal is to develop catalytic oxidations with 0_2 in ways that are efficient and environmentally friendly, ideally using light as an energy source.

"Oxidation is the most prevalent type of chemical reaction, occurring in nature and useful in industry. Oxygen is free and all around us. Light is provided by the sun. Thus the ingredients are freely available. What we need to do is to find a way to make them work together toward our goal," says Bakac.

Another research area for Bakac is the reactivity of nitric oxide (NO), a free radical so vital in biology, medicine, and the environment that it was named "Molecule of the Year" by the journal Science in 1992. Bakac's group has produced and studied several metal-based precursors that use visible light to release NO slowly and in a controlled manner, properties crucial for many applications

"My research team and I work to contribute to the basic understanding of how all these reactions happen on the molecular level, how fast they are, what intermediate states are involved, and how the conditions affect the outcome," says Bakac." In-depth understanding of a particular reaction gives you the power to tailor the outcome by changing temperature, pressure, reagent concentrations and other parameters. If you understand it, you can control it."

A scientist and a writer

Bakac will be retiring at the end of the year, and is thinking about the new directions her life will take outside of the lab. While she will include leisure time and travel, Bakac is also thinking about a second calling.

"I'm sure I will miss science. It will be hard to leave the lab, my colleagues and students behind. But science takes all of your time, energy, and enthusiasm, and there comes a point when you start thinking about other things that you are interested in and want to do before it is too late."

For Bakac that means picking up another thing she finds beauty in: literature. Not only does she have a lengthy backlog of books to read, she's got a plan to write some of her own.

"I have a diploma in children's literature, and I'm planning to write for children. I don't have a specific topic or story just yet, but whatever I write will have a strong science component to it."

Andreja Bakac