



橋 THE BRIDGE

MATERIALS ANALYSIS eNEWSLETTER

JANUARY 2023, ISSUE 114

WELCOME

Welcome to the first issue of *The Bridge* for 2023. It's almost a cliché to start by talking about the weather, but it has been an interesting winter thus far. Southeast Texas, where Rigaku Americas Corporation has its headquarters, experienced a two-day hard freeze in late December. While meteorological events like this are a rarity in this part of the state, they seem to be becoming more frequent. The temperatures then rose into the eighties ($F = 27C$) and have continued to oscillate between near-freezing and tropical ever since. The rains in California over the past weeks have broken many records. This may be what our future looks like, as the climate responds to the things humanity has done to the environment.

2022 was an interesting year, capped off by worldwide interest in the World Cup. Teams that hadn't qualified in decades had a chance to play on the global stage, and other teams that were not expected to perform well surprised everyone and brought a sense of pride to their fans at home. Events like this are a reminder that we all share this fragile planet and do better as a species when we recognize everyone else's place in the world.

We look forward to the new year, a blank slate full of possibility. Pharmaceutical research spurred on by the creation of the mRNA COVID-19 vaccine may translate into vaccines for other diseases. Materials science research may lead to breakthroughs in sustainable energy, new ways of disposing of plastics polluting the oceans, and more environmentally friendly ways of powering transportation. A resurgence in space exploration promises to propel the human race toward new frontiers.

Read on to discover what developments have made the news recently and learn about webinars, podcasts, application notes and a lab tour from Rigaku in the coming weeks and months.

IN THE NEWS

January 6, 2023: A research team has built and tested [a new interlayer to prevent dissolution of the sulfur cathode in lithium-sulfur batteries](#). This new interlayer increases Li-S cell capacity and maintains it over hundreds of cycles.

January 11, 2023: About a quarter of the world's electricity currently comes from power plants fired by natural gas. These contribute significantly to global greenhouse gas emissions and climate change. By gathering data from 108 countries around the world and quantifying the emissions by country, [a team has estimated that total global carbon dioxide emissions from the life cycle of gas-fired power is 3.6 billion tonnes each year](#). They found that this amount could be reduced by as much as 71% if a variety of mitigation options were used around the world.

January 12, 2023: [A new study demonstrates that electrodes can be made using just screen printing](#), creating a stretchable, durable circuit pattern that can be transferred to fabric and worn directly on human skin. Such wearable electronics can be used for health monitoring in hospitals or at home. Current commercial manufacturing of wearable electronics requires expensive processes involving clean rooms. While some use screen printing for parts of the process, this new method relies wholly on screen printing, which can make manufacturing flexible, wearable electronics much easier and less expensive.

January 17, 2023: [Chemists cracked the code to long-lasting Roman concrete](#), which could be a boon to the planet. The Pantheon and its soaring, detailed concrete dome have stood nearly 2,000 years, for instance, while modern concrete structures have a lifespan of perhaps 150 years, and that's a best case scenario. And the Romans didn't have steel reinforcement bars shoring up their structures.

January 17, 2023: A paper published in the journal *Nano Letters* describes a key advance: [the development of a kind of on-chip "factory"](#) for producing a steady, fast stream of single photons, essential to enabling photonic-based quantum technologies.

WEBINAR

[Joint Advanced Battery Webinar:](#)

ANALYTICAL METHODS TO ENSURE BATTERY RAW MATERIAL AND ELECTRODE

Do you want reliable tools to predict battery electrode quality and performance in development and production? Do you want to reduce scrap and increase process yield? The use of appropriate analytical technologies can allow you to accelerate electrode design based on new formulations and processes, and reliably control product quality. Rigaku and Micromeritics will together show how X-ray and physical textural analysis technologies can provide reliable determinations of density, elemental purity, surface area, porosity, and crystal structure that are essential to a high-quality anode or cathode.

Date/time
Thursday, February 2, 2023 - 07:00 CST

[Register >](#)

RIGAKU LAB TOUR DURING DGK

The annual meeting of the DGK will take place in Frankfurt from March 28 to 30, 2023—a stone's throw away of RESE's state-of-the-art laboratories in Neu-Isenburg—giving you the perfect opportunity to experience Rigaku's products and scientists on site and in effect. Join us in an exclusive all-access lab tour and watch up close as our application scientists present powerful analytical and diagnostic instruments and solutions. Transportation is provided.

[Register now for your limited spot!](#)

A PODCAST: UNDERSTANDING SEMICONDUCTORS

A podcast designed to connect semiconductor industry experts to explore their viewpoints about modern metrology from Lab to Fab for engineering leaders in characterization, metrology, process, and analytics, looking for discussion around semiconductor metrology challenges.

Each episode will feature a conversation with technology experts about problems facing the semiconductor metrology industry.

Podcast #9: Suman Datta – Advanced Computing and Georgia Research Alliance

WHAT IS THE NEXT BIG THING IN THE SEMICONDUCTOR INDUSTRY? (PART 2)

- Transistor Scaling
- Metrology
- CMOS

[Listen to Podcast >](#)

Podcast #4: An In-depth Discussion on Lithium-ion and Solid-State Batteries with Dr. Yang Wang

In this episode, Dr. Wang joins the show to discuss:

- The different types and energy densities of solid-state batteries
- How likely is the adoption of all solid-state batteries?
- What's the future of battery performance?
- The exciting current trends in the lithium-ion battery industry

[Listen to Podcast >](#)

FEATURED ARTICLE

Determination of Atomic-Scale Density of Materials from Total Scattering Profiles

by Masatsugu Yoshimoto and Kazuhiko Omote

Atomic-scale density (microscopic density) for non-crystalline materials is sometimes hard to obtain when the sample contains microscopic grains and/or pores. This is also the case for crystalline materials that contain atomic scale defects. We propose a method for the determination of the microscopic density of an amorphous sample from total scattering data. Theoretically, the microscopic density can be calculated from the slope of the pair distribution function $G(r)$ in the short-distance region from zero to the nearest neighbor. However, the observed $G(r)$ in this region is greatly affected by unphysical modulation of the experimental scattering data and the derived structure factor $S(Q)$. As a result, the estimated microscopic density has a large uncertainty. The proposed method removes the unphysical modulation of $S(Q)$ and obtains a $G(r)$ that satisfies theoretical conditions only using the coherent scattering intensity and the first neighbor distance. We have applied the present method to SiO_2 glass, crystalline Ni powders, and a set of data from germinite glasses whose densities have been reported. The results of the present method are consistent with the reported values within $\pm 5\%$.

[Read more >](#)

FEATURED APPLICATION NOTES

EDXRF

Aluminum and steel are often coated with a protective conversion coating, also called passivate or passivation coating, to prevent oxidation and corrosion of the base metal. Conversion coatings include chromium (Cr), titanium (Ti), vanadium (V), manganese (Mn), nickel (Ni), phosphorus (P), or zirconium (Zr). A phosphate coating may also be applied to minimize wear on cutting tools and stamping machines. Aluminum is often coated for use in aircraft parts, aluminum window frames, and other similar industries where the aluminum is exposed to weathering. Steel for the automotive industry is typically first galvanized with a zinc coating before the conversion coating is applied. Protected steel is also used for outdoor sheds and other similar uses where steel is exposed to weathering. Conversion coating also helps in the retention of paint for the final finished product.

Chromium on Aluminum

Applied Rigaku Technologies

The measurement of chromium (Cr) conversion coating on aluminum is demonstrated.

[Read More >](#)

Titanium on Aluminum

Applied Rigaku Technologies

The measurement of titanium (Ti) conversion coating on aluminum is demonstrated.

[Read More >](#)

Zirconium on Aluminum

Applied Rigaku Technologies

The measurement of zirconium (Zr) conversion coating on aluminum is demonstrated.

[Read More >](#)

XRD

Twist width evaluation of group III-V nitride films by rocking curve measurement

Rigaku Corporation

Deep ultraviolet LEDs are preferable for wide use as an alternative to mercury lamps since they are ultraviolet sources with low environmental impact. In recent years, their sterilization function has been especially attracting great attention, and practical application of this function is expected soon. To increase light emission efficiency and carrier lifetime, the quality of the AlN layer, which is the base for the active layer, must be improved. In this measurement example, an appropriate evaluation method was examined for the crystal orientation distribution (twist width) in the in-plane direction, which is used as an indicator of the threading edge dislocation density of the AlN layer.

[Read More >](#)

WDXRF

Chlorine Analysis of Aluminosilicate for Fluid Catalytic Cracking Catalyst by WDXRF

Rigaku Corporation

It is important to control the chlorine content of FCC catalyst to guard against the formation of hazardous organo-chloride compounds such as dioxins and to prevent degradation of catalytic activity. This application note documents the performance of a Rigaku ZSX Primus IV spectrometer for analysis of chlorine in FCC aluminosilicate catalyst.

[Read More >](#)

WDXRF

Lead Analysis in Gasoline — ASTM D5059-21 — Using Benchtop WDXRF Supermini200

Rigaku Corporation

Although lead-free gasoline, called unleaded gasoline, is common in most countries or, intentionally—in some countries—either intentionally or intentionally—in some countries. Therefore, it is necessary to check the lead concentration in gasoline. This application note demonstrates quantitative analysis of low concentration lead in gasoline according to ASTM D5059-21 on Rigaku Supermini200, a benchtop wavelength dispersive X-ray fluorescence (WDXRF) spectrometer.

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