SUMITOMO CHEMICAL
ADVANCED TECHNOLOGIES

FOR IMMEDIATE RELEASE: 27 April 2020
PR # SCAT-03-20

SUMITOMO ENGINEERS NEW LCPs FOR RIGORS OF 5G CELLULAR COMMUNICATIONS, AUTONOMY

Low & consistent dielectric constant, loss tangent at high frequency, broad temperature, humidity ranges ideal for changing interconnect environment

Phoenix, Ariz., U.S. — Much has been written[1] about how critical 5G cellular technology is to the successful rollout of affordable, safe, and reliable Level 5[2] vehicle autonomy owing to the need for much higher volume, super-high-speed data transfer with very-low-latency between vehicles, infrastructure, and infotainment sources. However, 5G systems requirements will change not only the design of electronic components but also the types of materials used to produce them, which is leading to development of new polymers with unique properties that deliver properties required in the 5G environment to ensure very-reliable, high-speed data transfer at low latency and low signal loss. Sumitomo Chemical Advanced Technologies *(here)* has introduced new liquid crystal polymers (LCPs) with very-low and consistent dielectric constant and very-low dissipation factor (loss tangent) and is offering data to help electrical engineers better understand and simulate the performance of these materials.

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[1] https://www2.deloitte.com/us/en/insights/focus/future-of-mobility/overview.html ; https://www.machinedesign.com/mechanical-motion-systems/article/21837614/5gs-important-role-in-autonomous-car-technology ; https://www.zdnet.com/article/why-5g-is-a-crucial-technology-for-autonomous-vehicles/ ; https://www.telekom.com/en/company/details/5g-network-as-foundation-for-autonomous-driving-561986 ; https://www.lightreading.com/the-edge/5g-and-autonomous-cars-flashy-promise-meets-complicated-reality/d/d-id/755912 ; https://www.cnet.com/news/5g-could-make-self-driving-cars-smarter-commutes-safer/ ; https://www.forbes.com/sites/bijankhosravi/2018/03/25/autonomous-cars-wont-work-until-we-have-5g/#466bf88b437e ; https://www.kearney.com/communications-media-technology/article/?/a/5g-a-key-requirement-for-autonomous-driving-really- ;

[2] https://www.truecar.com/blog/5-levels-autonomous-vehicles/

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Sumitomo Introduces New Liquid Crystal Polymers Specifically Designed for 5G Applications
2-2-2-2

Designers developing electronic devices for 5G face many challenges. One issue is that many 5G applications (like autonomous driving) will require near-real-time access to large volumes of rapidly changing data with minimal delay or distortion in order to mimic human reaction times and ensure safe operation of self-driving vehicles. That necessitates that materials used in connectors, cables, and other components deliver very-low latency and very-low signal loss. Another problem is managing the thermal load caused by the quadruple challenges of continuing interconnect densification and device miniaturization, plus the need to operate at much higher processing speeds and frequencies (in the gigahertz range), all of which increase device operating temperatures and make it harder to disperse such heat. That necessitates use of materials with broader levels of thermal and hydrolytic stability to ensure consistent performance and data transmittance in the heat and humidity of a Florida summer as well as a cold, dry Wyoming winter. Of course, the electronics industry also is challenged by shorter development cycles and the need to find cost-effective solutions to ensure the 5G rollout is affordable for a large number of companies and individuals.

To meet these trends, Sumitomo Chemical has expanded its LCP offerings with two thermotropic, injection moldable or extrudable polyester-based LCP grades specifically formulated to meet the needs of 5G. Available in natural and black colors, both SumikaSuper™ E6205L and SumikaSuper SR1205L are characterized by lower dielectric constant values than standard LCP grades — a property necessary to enable reliable, higher volume data transmission. However, owing to the fact that it has been designed using a new LCP base chemistry, SR1205L is further distinguished by its lower dissipation factor (lower loss tangent), critical for ensuring reliable data transmission even in the gigahertz/millimeter-wave frequency ranges. Novel chemistry and polymerization technology also bring other benefits to the SR1205L grade. To assist electrical engineers in better understanding the relationship between material properties and electrical behavior, as well as to improve simulation accuracy, Sumitomo has retained an independent testing firm to develop performance data on SR1205L at different frequencies, temperatures, and humidity levels. Testing has shown that the polymer offers very consistent dielectric constant over a broad range of temperatures (-40°C, 22°C, 80°C, and 120°C) and frequencies (1 to 25 GHz) and does a better job of retaining its tensile strength vs. standard polyester-based LCPs even at high temperatures (120°C), relative humidity levels (100% RH), and pressures (2 atm) for up to 200 hours thanks to higher hydrolysis resistance. (Initial testing of E6205L shows similar trends.) In other physical, mechanical, and processing properties, the new grades perform much like standard LCPs.

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Sumitomo Introduces New Liquid Crystal Polymers Specifically Designed for 5G Applications
3-3-3-3

LCPs are a family of polymers that produce thermoplastic parts with unique processing characteristics and extremely high performance, which is why they are commonly used to replace metals, ceramics, and other plastics. Most commercial LCPs are aromatic polyesters characterized by high thermal and mechanical performance, inherent flame retardancy, good weatherability, excellent electrical properties[3], high resistance to stress cracking, and chemical inertness.[4] This makes them ideal for use in electrical and electronic components (including fiberoptic cables, printed circuit boards, chip carriers, connectors (conventional, radio-frequency (RF), and fiber-optic), and other surface-mount components), microelectromechanical systems (MEMS), automotive applications (including components for ignition and transmission systems, lamp sockets, pump components, coil forms, and sensors), printer/copier/fax components, cookware, high-barrier/retort-processed food containers, plus components for chemical processing (including pumps, meters, and valves).

Commonly processed by injection molding, LCP parts can be joined using many thermoplastic welding techniques, especially ultrasonic and laser welding. Owing to the highly rigid structure of their molecular chains, the weak van der Waals forces between molecular chains, and their liquid crystalline nature — which tend to be nearly linear and to occupy a stacked orientation that maintains its order regardless of solid or liquid phase — LCP polymer chains align easily in the flow direction and are highly anisotropic. This not only accounts for their excellent mechanical properties, which results from the self-reinforcing orientation, but also for the high flow and molding productivity that characterize these materials.

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[3] Electrical properties include high electrical resistivity, low relative dielectric constant, and low dissipation factor.
[4] Resistance is excellent to strong and weak acids, alcohols, esters, ketones, and aromatic, chlorinated, and halogenated hydrocarbons over a broad range of temperatures. Hydrolytic stability in boiling water also is excellent. LCPs can be attacked by high-temperature steam, concentrated sulfuric acid, and boiling caustic chemicals. A more comprehensive treatment of the chemical resistance of LCPs is shown in Table 1 at **https://www.sumitomo-chem.co.jp/sep/english/products/lcp/lcp_bs_kagaku.html**.

Sumitomo Introduces New Liquid Crystal Polymers Specifically Designed for 5G Applications
4-4-4-4

Most thermoplastics and especially fiber-reinforced thermoplastics exhibit some anisotropy after processing. However, molded properties of LCPs can vary significantly between flow and cross-flow directions[5]. Hence, care should be used when designing parts and tools for LCPs to take advantage of (and avoid the challenges of) this characteristic. High anisotropy means weldlines (where flow fronts with different molecular orientations converge) are weaker and prone to warpage and thermal-expansion differentials. Hence, LCPs are typically reinforced with glass fiber and mineral fillers — not so much to increase stiffness and strength but to reduce anisotropy. Warpage also can be reduced with proper gate design in the tool. Because of their high performance, LCPs are priced accordingly. However, given their high melt flow rates, fast setup times, and low thermal expansion in the direction of flow, LCPs can be formed into thin-wall parts with short molding cycles that deliver high performance at low mass and lower material usage — all of which help offset higher initial material costs. The thermal stability typical of LCPs enables processors to efficiently reuse regrind and recycle reject parts, which again reduces material losses and lowers effective part cost.

Depending on design and thickness requirements of a given connector program, Sumitomo Chemical can help electrical engineers select a suitable LCP grade and provide appropriate data to help engineers design components better, faster, and with higher value. The company has produced polyester-based LCPs since 1972 and offers dozens of compounds as well as alloys with other high-performance thermoplastics like polyethersulfone (PES) to meet a wide range of mechanical and thermal (from 260°C to 360°C) requirements. Additionally, the company also is known for its high-quality technical support — from part design to on-site molding assistance.

Sumitomo Chemical Advanced Technologies LLC — formerly called Sumika Electronic Materials and a wholly owned subsidiary of Sumitomo Chemical Co., Ltd. — is a leading manufacturer of liquid crystal polymer (LCP), polyethersulfone (PES), and high-performance alloy resins. The company serves as the U.S. base of operations and customer support for Sumitomo Chemical's photoresist and engineering plastics businesses and is certified to ISO9001:2015* and ISO14001:2015* standards. For more information, see http://www.sumikamaterials.com or call +1.602.659.2500.

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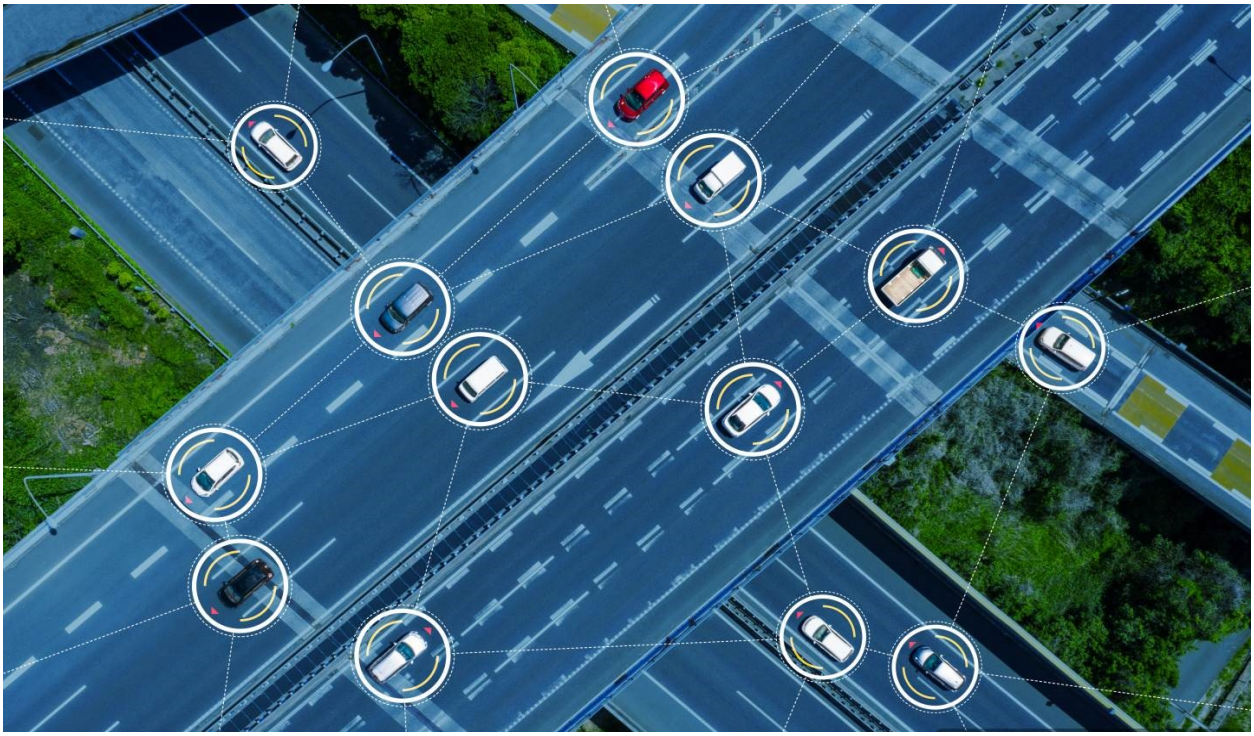
[5] It has been reported in the literature that anisotropic-dependent properties (e.g. tensile strength, coefficient of linear thermal expansion (CLTE), and elastic modulus) can be up to 3x greater in the flow vs. cross-flow direction. LCPs also have a high Z-axis CLTE.



FOR IMMEDIATE RELEASE: 27 April 2020
PR # SCAT-03a-20

Phoenix, Ariz., U.S. — For safe operation, 5G applications like autonomous driving will require near-real-time access to large volumes of rapidly changing data processed with minimal delay or distortion in order to mimic human reaction times. Connectors and other electronic components used in 5G cellular communication systems need very-consistent performance over a broad range of temperatures, humidity, and atmospheric pressures to ensure self-driving vehicles are as safe to operate in a hot, humid Florida summer as in a dry, cold Wyoming winter. Sumitomo Chemical Advanced Technologies *(here)* has recently introduced two new liquid crystal polymers (LCPs) with very-low and consistent dielectric constants and very-low dissipation factor (loss tangent), which are critical to ensure very-reliable, high-speed data transfer at low latency and low signal loss.

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Attention Editors: High-resolution digital artwork available upon request. Image courtesy of iStockPhoto.com.

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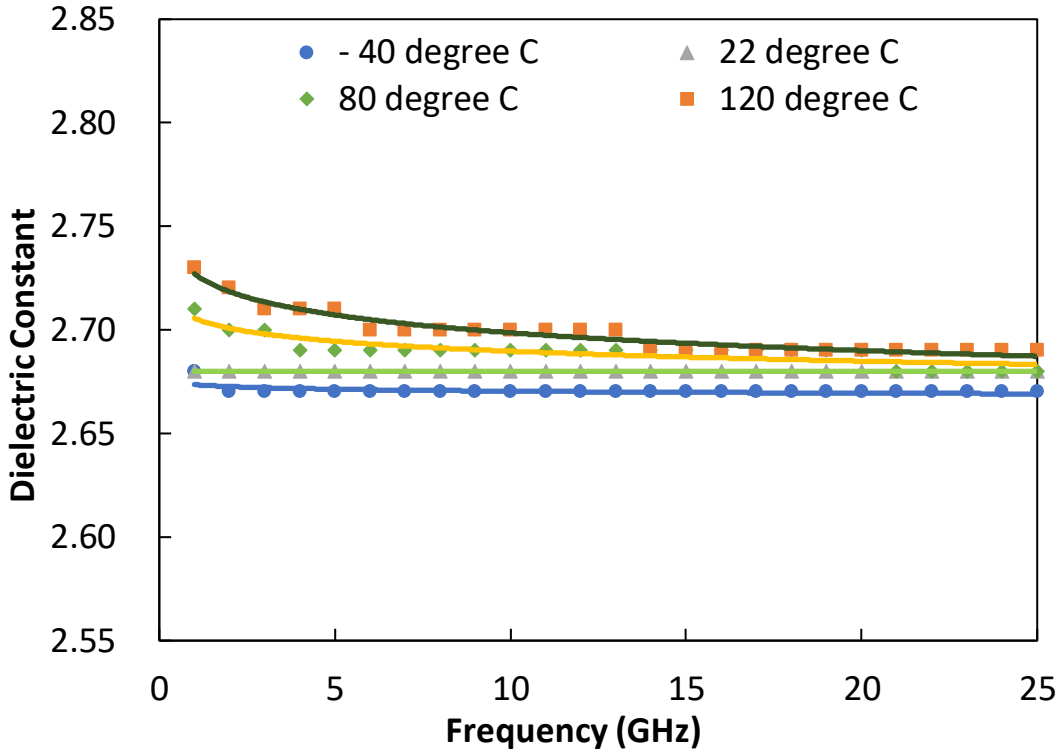

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PR # SCAT-03b-20

Phoenix, Ariz., U.S. — Two new liquid crystal polymers from Sumitomo Chemical Advanced Technologies *(here)*, specifically designed for connector use in the 5G environment, offer very-low and consistent dielectric constants over a broad range of temperatures. Shown above are dielectric constant data for SumikaSuper™ SR1205L LCP at -40°C, 22°C, 80°C, and 120°C and frequencies ranging from 1 to 25 GHz.

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™ SumikaSuper is a trademark of Sumitomo Chemical Co., Ltd.

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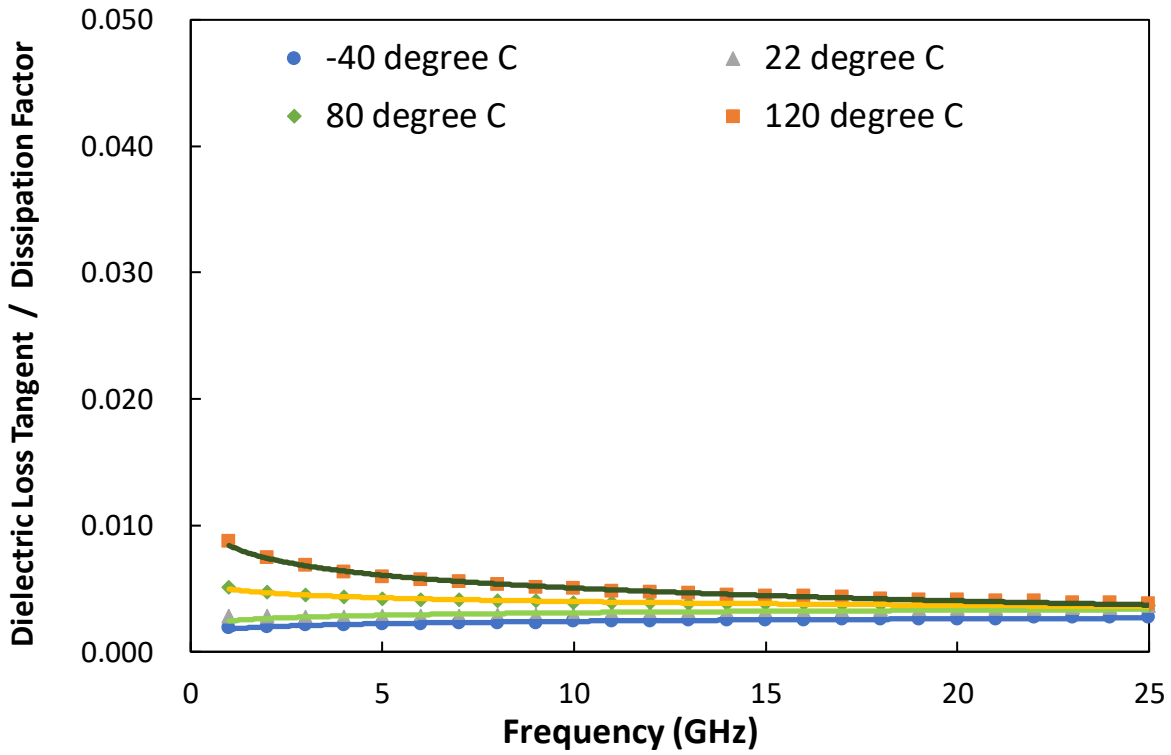

FOR IMMEDIATE RELEASE: 27 April 2020
PR # SCAT-03c-20

Phoenix, Ariz., U.S. — SumikaSuper™ SR1205L liquid crystal polymer from Sumitomo Chemical Advanced Technologies has demonstrated very-low and consistent dielectric loss tangent (dissipation factor) over a broad range of temperatures (-40°C, 22°C, 80°C, and 120°C) and frequencies (1 to 25 GHz) making it ideal for connector use in the 5G communications/vehicle autonomy environment.

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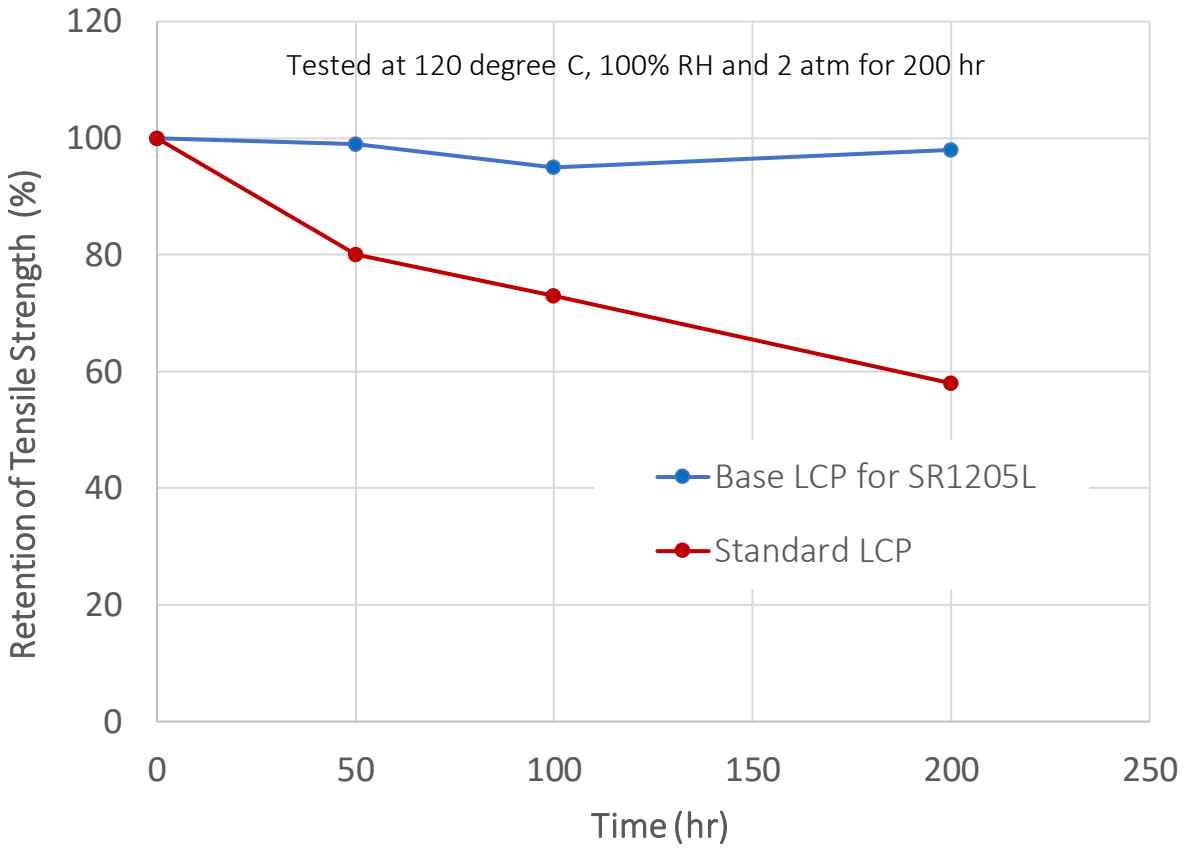

FOR IMMEDIATE RELEASE: 27 April 2020
PR # SCAT-03d-20

Phoenix, Ariz., U.S. — A new grade of liquid crystal polymer from Sumitomo Chemical Advanced Technologies called SumikaSuper™ SR1205L retains more of its tensile strength at high temperatures (120°C), relative humidity levels (100% RH), and pressures (2 atm) than conventional LCP polymers after 200 hours of testing.

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