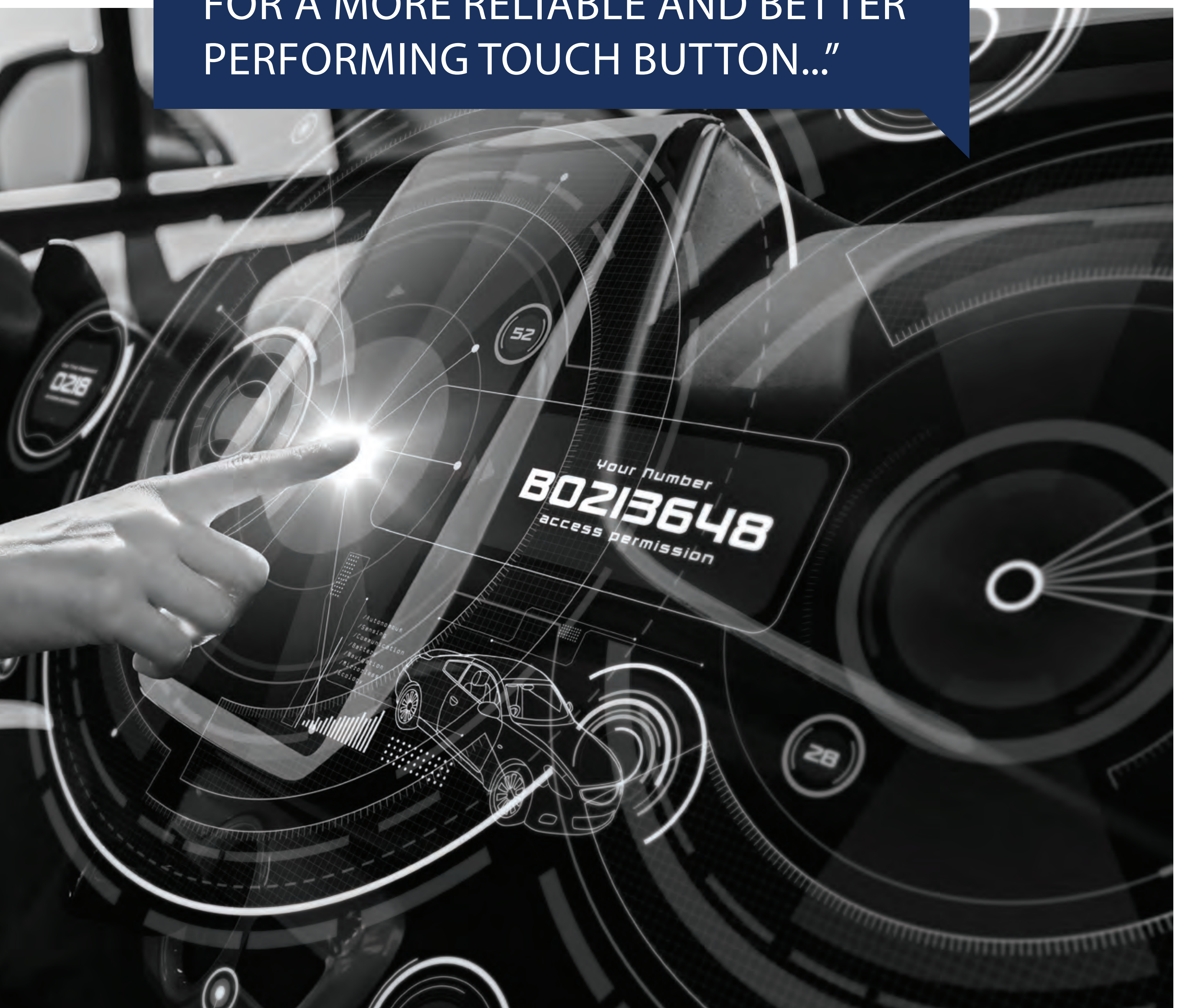
CAPACITIVE TOUCH SENSOR GUIDE:

CHOOSING THE APPROPRIATE ELECTRODE MATERIAL

> “WHEN APPROPRIATELY CHOSEN, THE ELECTRODE MATERIAL WILL ALLOW FOR A MORE RELIABLE AND BETTER PERFORMING TOUCH BUTTON...”



4 KEY ELECTRODE MATERIAL CHARACTERISTICS

Designing a capacitive touch sensor or a product with a capacitive touch sensor? Then one key element impacting both the design and manufacturing process is the electrode materials. The electrode material must not only provide optimal performance, but must also deliver the required durability to operate successfully in the intended environment and be cost effective to manufacture. Choose well and you'll have satisfied customers happy with your new product. And if you choose wrong, brace yourself for product returns, warranty requests, and the wave of hate from social media. Even the behavior of the touch sensor relies on the material you choose for your electrode. Traditionally, Indium Tin Oxide (ITO) has been used for capacitive touch sensors on flat surface designs, often times made from glass. However, with designers and engineers looking for ways to incorporate different forms and shapes into their designs (think flexible, thermoformed or bent) ITO is no longer the best option. ITO is far too brittle which results in it shattering when introduced to any flex stressors. This reason is compelling designers and engineers to look for alternative electrode materials.

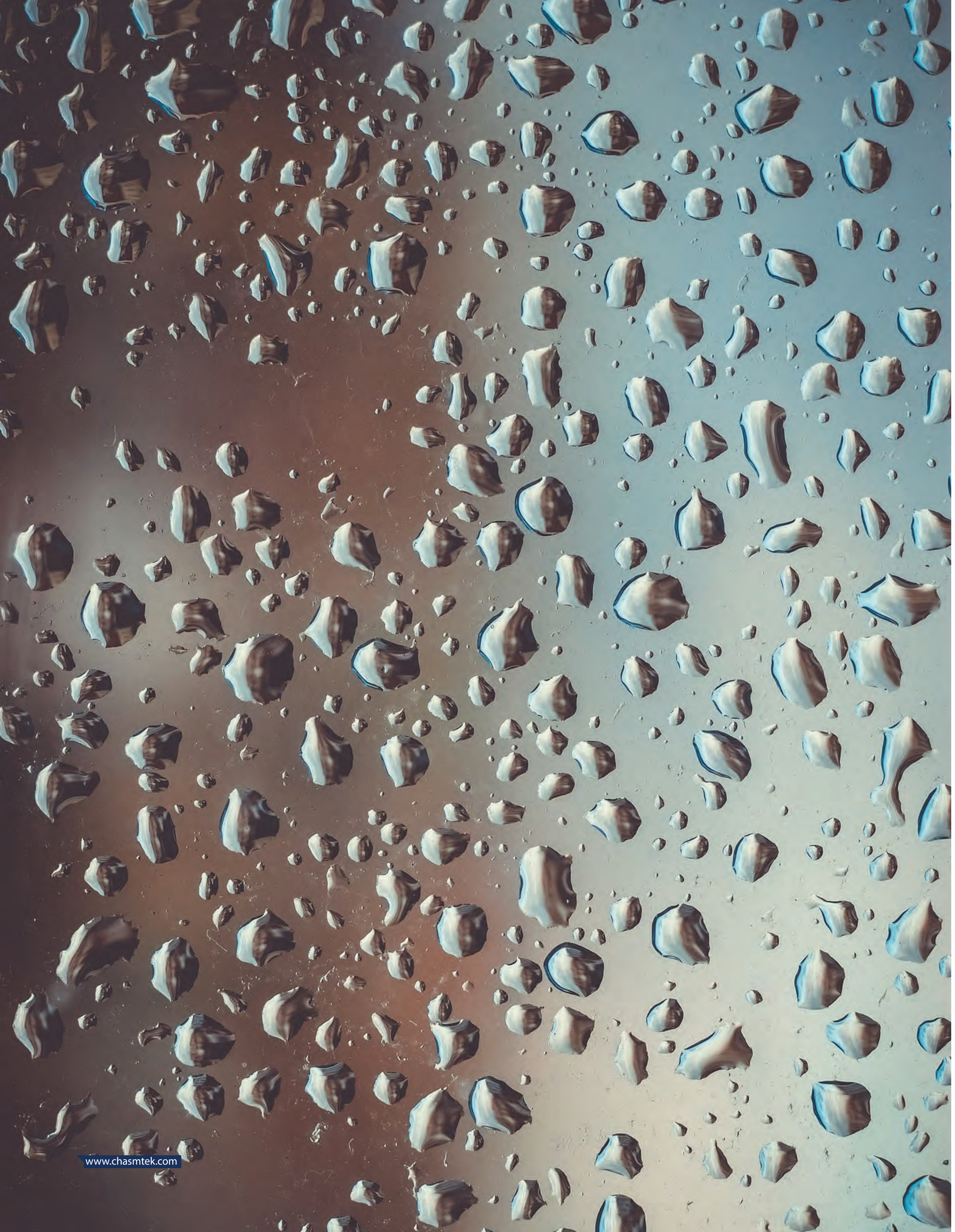
There are numerous ITO alternatives commercially available today. For engineers – it's all about choosing which ITO alternative has the correct grouping of characteristics for your project. These characteristics are organized into 4 groups: Optical, Electrical, Mechanical and Environmental.

OPTICAL

The optical characteristics of an electrode material incorporated into a touch sensor are fundamental to how the electrode will perform. The right material will be "clear" enough to not obstruct or negatively impact the view of the screen. Although some conductors can appear "clear", they may have particular color tint giving an unwanted color cast from the screen. In reviewing the optical characteristics of any electrode material, it is important to focus on two factors: transmittance and haze. Optical transmittance, also known as Visible Light Transmittance (VLT) indicates the fraction of visible light transmitted through the material. When looking to incorporate capacitive touch sensors into a touch screen device, this property becomes increasingly important. VLT values are measured from 0% (opaque) to 100% (transparent). For many applications in the touch screen industry, an acceptable level of VLT is generally 85% VLT or higher. However – that's not just the measurement for the electrode material – that for the entire stack up of materials comprising the finished touch screen product. So, you'll want an electrode material with a high VLT (90%+). For other applications such as touch buttons on a curved face or control panel of an appliance, this is also important so that any backlighting added to enhance the visual appeal of the sensors is appropriately represented.

Another important optical characteristic is haze. Haze is caused by the reflection of light within the electrode materials and the presence of haze causes a cloudy/murky look on the touch screen. As such, engineers and designers typically target a limit of 2% or less for haze. This does depend on the application of your capacitive touch sensors, so it's always good to know the appropriate level for your application or product.

A third and final optical characteristic to mention is tint. Some commercially available ITO alternatives have a color cast to the material. If you plan to backlight your sensors and you want a neutral light or bright white light, you'll need to consider the inherent color properties of your electrode material to ensure it does not create an unwanted tint that will adversely affect your design.



ENVIRONMENTAL

Resistance to temperature, humidity and UV (i.e. environmental stability) can be a make or break characteristic depending on the end use and application that your electrode material will be servicing.

What environment is the device going to be used in? If the intended operational environment is outside or in a vehicle where it could be exposed to UV from the sun, to atmospheric humidity or to heat from direct sunlight exposure, environmental stability will be critical. It's also an important consideration for applications in home appliances such as ovens, dishwashers, washers/dryers where exposure to moisture and elevated temperature are common.

Temperature and humidity testing, sometimes called thermal testing, will provide you with excellent baseline data for your electrode material. Extreme thermal testing may even take the temperature from -73°C to 190°C, the humidity range from 10% to 95% RH and a drastic temperature transition rate of 1°C per minute up to 25°C per minute. Rapidly cycling temperatures in environmental testing is sure to highlight material incompatibilities and weaknesses as materials expand and contract in response to the temperature fluctuations.

It is important to think through the environmental stability of your electrode material to help your company to avoid a potential warranty recall when matching an electrode material for a particular project or product.

MECHANICAL

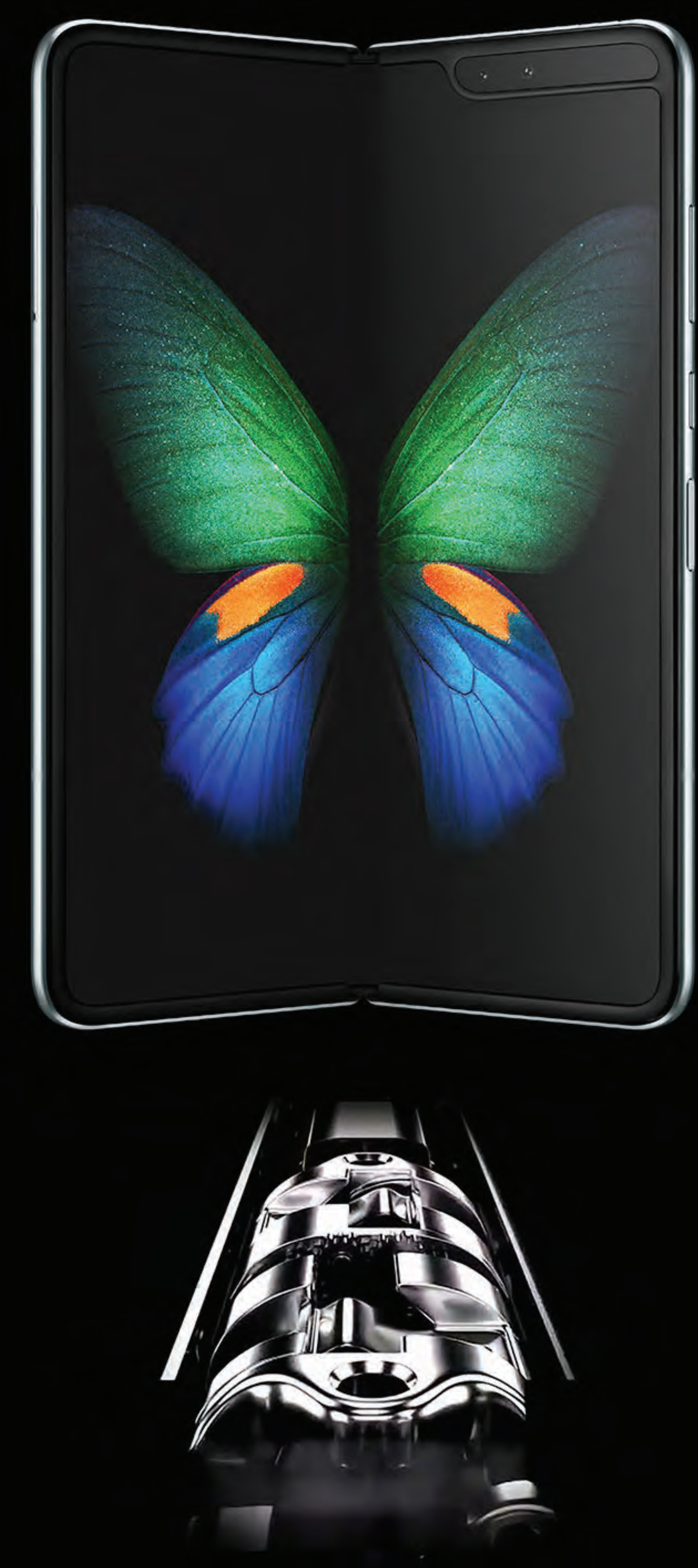
The mechanical characteristics of the electrode material should ideally match the mechanical characteristics of the final product. For example, if your final product will be bent or formed, then the electrode material you choose to use should have properties that enable it to be bent or formed. You don't want your product to have a failure in testing or worse, in the hands of the customer, just because your electrode material is too rigid for your sculpted product.

Many capacitive sensor designers and engineers are finding that ITO is far too brittle to use in their cutting-edge designs for wearables or for curved and formed smart surfaces in automotive interiors.

More specifically this tends to be relevant for in-mold electronics, where the flexible printed circuit is thermoformed and/or injection molded into the desired shape. Forming the material causes bending and stretching in the electrode during the process. Also, the electrode materials need to be robust enough to withstand the temperature and pressure of processing. The applications /markets gaining most traction for in-mold electronics are automotive interiors and home appliances, rather than wearables.

You may hear people talk about bendable and stretchable materials for wearables but what they are talking about is elastic type substrates, that can be repeatedly stretched and recovered (think medical sensors and electrodes or sports monitoring etc.). For in-mold electronics, the elongation typically only occurs during forming.

If you are unsure about your application or a particular electrode material, look for performance data from bending tests or a stress-strain tests.

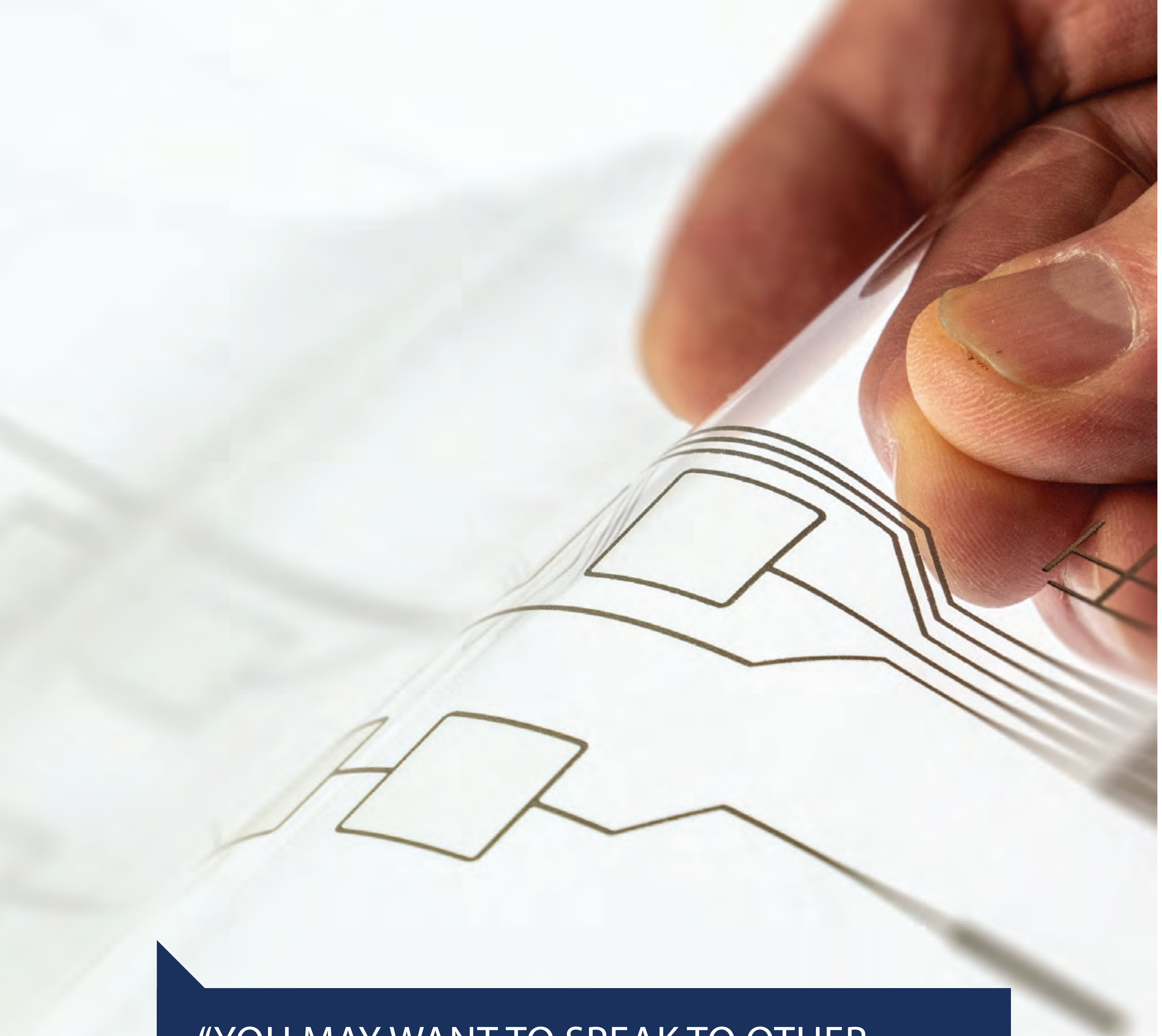


ELECTRICAL

The electrical performance of your capacitive touch sensor will depend on the resistivity of the material used. Resistivity is measured by sheet resistance and when designing any electrode for capacitive touch sensors, generally the lower the sheet resistance of the material the better - as this delivers faster response time to the rest of the circuit.

You will see particular ITO alternatives advertising nominal sheet resistance measured in ohms/square. This measurement takes the sheet resistance and the thickness of the material into consideration. You'll see a range from 1 ohm/square to over 100 ohms/square. Knowing what kind of resistivity your application requires is key. Designing a touch sensor into any product that does not function as the consumer expects (is delayed, slow, unresponsive, falsely registers) can lead to customer frustration. You don't want your innovative product to become an annoyance to your consumers simply because of an improper electrode material and product match.

If you are unsure about the kind of sheet resistance your project requires, you may want to speak to a third party who specializes in conductive thin films. They will be able to pair your application with the appropriate conductive sensor material. They will take the application into consideration and pair the project with a material that possesses the appropriate amount of sheet resistance.



> “YOU MAY WANT TO SPEAK TO OTHER STAKEHOLDERS IN YOUR ORGANIZATION TO GATHER THEIR INPUT ON HOW ELECTRODE MATERIAL CHOICE MAY AFFECT THE BUSINESS...”

SO, WHAT MATERIAL IS BEST?

Good design is not about finding “the” answer, but finding the “optimal” answer. Successfully answering the electrode material questions can be done by weighing the pros and cons of each potential material you may use against the “must haves” of your team’s design and engineering requirements. If you don’t require formability or thermoforming, then you just need to find an electrode material that has a low sheet resistance, low haze and high VLT. However, if you need a material that’s bendable, flexible, formable or for use in smart surfaces – you must take that into consideration and look for electrode materials that ticks all the boxes. It’s also important to think about manufacturing and supply chains in this process. Is one material easier to prototype with? Or less costly when manufactured in bulk? Do you want to start using a material that can grow with your product or product line as you make new innovations? You may want to speak with other stakeholders within your organization to get their input on how your electrode material choices may positively or negatively affect the business.

FORWARD TO A FRIEND

CHASM™

STAY IN TOUCH

480 Neponset Street,
Building 6
Canton, MA

+1 781 989 1416
info@chasmtek.com

WWW.CHASMTEK.COM

Your Solutions, Our Materials.