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Global Signaling of Localized Impact in Chemo-responsive Gels

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A vital function performed by skin is to send a chemical alarm signal throughout the system in response to irritation or damage. Using our recently developed 3D model for chemo-responsive gels, we design a coating that can perform an analogous, biomimetic function. Our system consists of a polymer gel undergoing the Belousov-Zhabotinsky (BZ) reaction. We show that such coatings respond to a spatially localized mechanical force by exhibiting a range of signaling behavior. For example, an initially stationary gel can emit transient waves in response to a sufficiently weak, localized impact. A stronger localized impact, however, can generate a global signal, which encompasses both chemical waves and surface ripples that propagate across the entire sample. This complex dynamical response persists even after the force is lifted. Furthermore, the spatial patterns formed by these oscillating gels reveal the location and magnitude of the applied force. Our findings open up the possibility of harnessing BZ gels for a range of applications, such as creating sensors that transmit a global signal in response to a local mechanical impact.