Optical keys that can stand the heat:

Researchers from the Nanophotonics group (Debye Institute for Nanomaterials Science, Utrecht University), The Complex Photonic Systems group (COPS, MESA+ Institute for Nanotechnology, University of Twente), and Schott AG, Germany, the leading producer of specialty glasses and glass ceramics, have invented a new class of materials for physical security keys, known as Physical Unclonable Keys (PUKs). PUKs are tiny pieces of randomly nanostructured materials that are impossible to duplicate with foreseeable technology. Their complex light scattering properties can be used to verify your identity [1] or to decode messages [2], while faking and eavesdropping are forbiddingly difficult. The new invention concerns materials which have all properties that are desirable of a good key: They scatter light strongly to provide good security, and are extremely tough and durable to resist the influence of temperature and wear. The secret, disclosed in a patent [3] is to use glass ceramics. Glass ceramics are glasses loaded with crystalline nanoparticles, which give them excellent mechanical and thermal properties as well as desirable light scattering. An example of a glass ceramic that is found in many homes is Schott CERAN®, which is used to make ceramic cooking plates (the ones that don't crack even if you accidentally drop cold water on a hot plate). The major difference? Optical keys are a lot smaller, the size of a pin's head, and white.

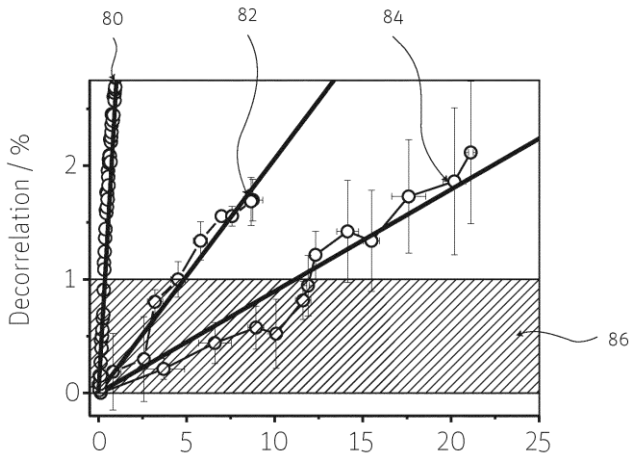

Illustration from the patent application: Decorrelation vs. temperature change. Temperature compensated glass ceramic (84) is much more stable against temperature changes than ordinary glass (80) or non-compensated glass ceramic.

[1] S. A. Goorden, M. Horstmann, A. P. Mosk, B. Skoric, and P. W. H. Pinkse, Quantum-secure authentication of a physical unclonable key, Optica 1, 421-424 (2014).

[2] R. Uppu, T. A. W. Wolterink, S. A. Goorden, Bin Chen, B. Škorić, A. P. Mosk, P. W. H. Pinkse, Asymmetric *Cryptography with Physical Unclonable Keys*, arXiv:1802.07573

[3] M. Davis, M. Letz, A.P. Mosk, and P.W.H. Pinkse, "Optical key protected authentication and encryption", EP 16172091.7 (2018).