Photonic encryption of inverse opals with combinatorial codes

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Colloidal photonic crystals possess inimitable optical properties of iridescent structural colors and unique spectral shape, which render them useful for security materials. However, micropatterning of the photonic crystals and encoding hidden messages remains an important challenge. In this work, we report a novel method to encrypt graphical and spectral codes in polymeric inverse opals to provide advanced security. To accomplish this, we prepare lithographically-featured micropatterns on the top surface of hydrophobic inverse opals, which serve as a shadow mask against surface modification of air cavities to be hydrophilic. The combinatorial code composed of graphical and optical codes is revealed only when aqueous solution agreed in advance is used for decoding. In addition, the photonic structures are chemically stable, maintaining the invariant combinatorial codes for many cycles of uses and a long storage period. Moreover, the film can be released from substrate to be freestanding, which can be further transferred into any surfaces for anti-counterfeiting purpose. This novel materials and encryption technology will provide new opportunity in a wide range of security applications.