Three-Dimensional Quick Response Code based on Inkjet Printing of Upconversion Fluorescence Nanoparticles for Drug Anti-Counterfeiting

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Counting details of UCNPs content in one 3D QR code

$$n_{drop} = \frac{Area_{3D\ code}}{Area_{drop}},$$

n_{drop} is the number of ink droplets costed in printing one 3D QR code. $Area_{3D\ code}$ is area of one 3D QR code. $Area_{drop}$ is area of one ink droplet printed on the substrate. Here the printing resolution we used was 600 dpi (dots per inch), which decided the $Area_{drop}$ is 1406.8 μm^2 at most. Area of each 3D QR code ($Area_{3D\ code}$) is 10^8 μm^2. Therefore, n_{drop} is about 7.1×10^4.

$$m_{UCNPs} = C_{UCNPs} \times v_{drop} \times n_{drop},$$

m_{UCNPs} is UCNPs mass contained in one 3D QR code. C_{UCNPs} is the concentration of UCNPs in upconversion ink. v_{drop} is the volume of one ink droplet. Here, v_{drop} is ~1 pL and C_{UCNPs} is ~5 mg/mL. In consequence, one 3D QR code contains approximately 355 ng UCNPs.

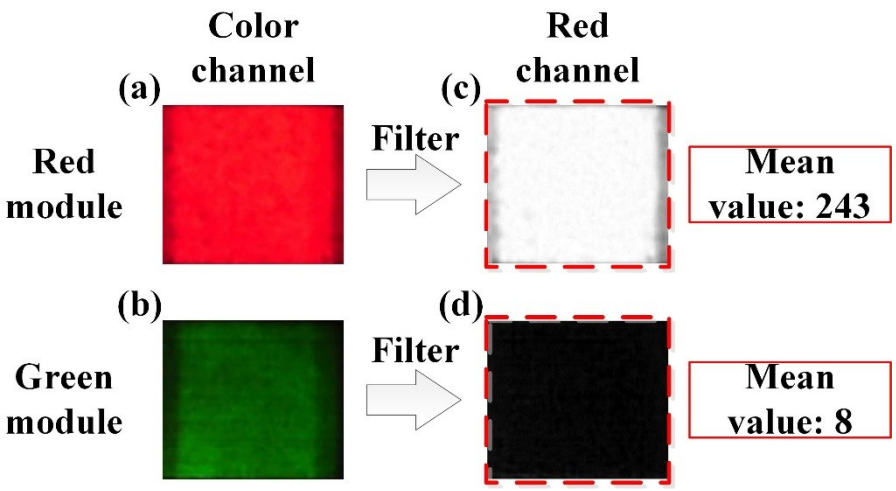

Figure. S1 Images of (a) red module and (b) green module printed by red and green luminescence inks in color channel and (b, d) their grayscale image in red channel.

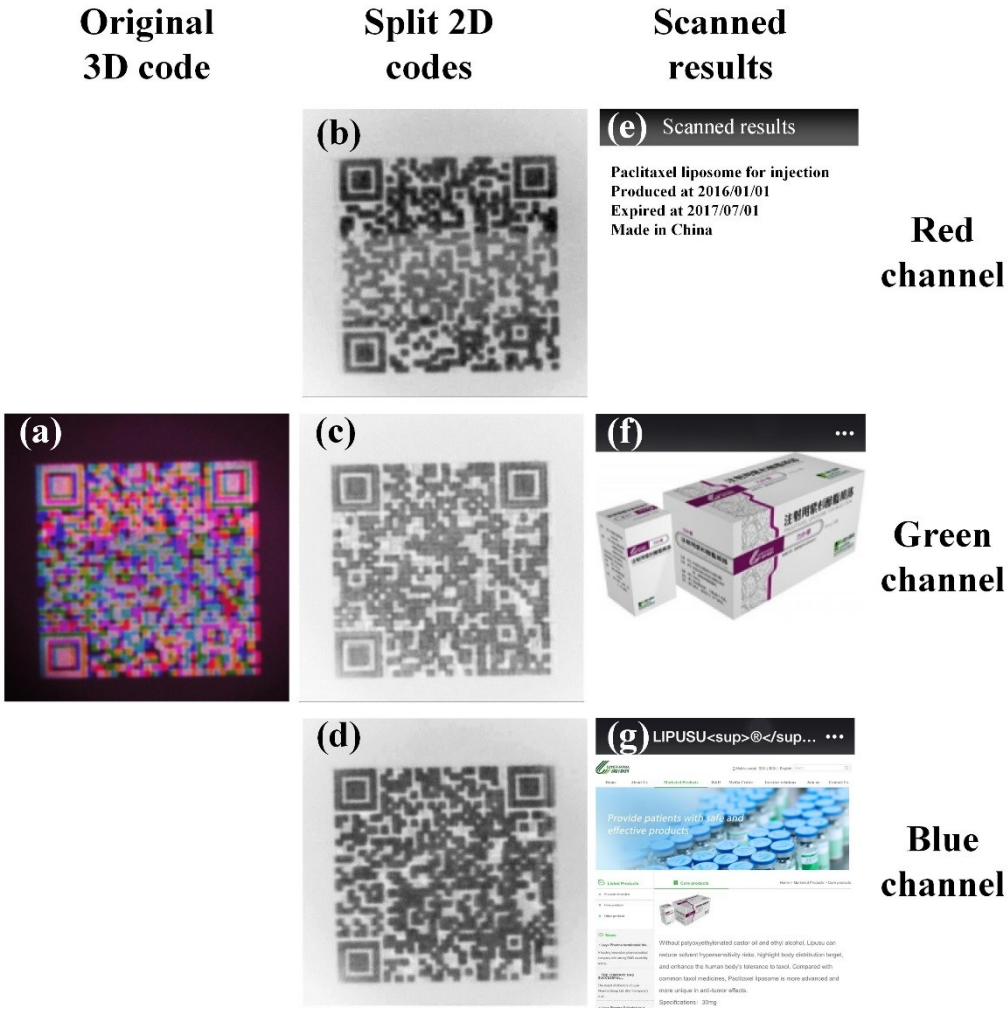

Figure. S2 (a) 3D QR code and three 2D QR codes split from it through (b) blue channel, (c) green channel and (d) red channel. (e-g) Decoding results of corresponding split 2D QR codes.