where *p(μ, n)* represents the probability containing n photons in a single pulse with the average photon number μ and *ρ(n, V)* is avalanche voltage signal distribution. By fitting the experimental data in accordance with Eq. (1.2), we got the average detected photon number as 4.52. The photon-number-resolving capability of the MPPC was well reserved in the presence of Au nanoparticle deposition. As shown in Fig. 4(b), without the Au nanoparticles, the average detected photon number was 3.61 under the same light incidence. The enhancement of the detection efficiency was calculated to be 1.29, in agreement with the above-mentioned test.

3. Conclusion

In conclusion, the detection efficiency of MPPC-based photon-number-resolving detector was enhanced by surface decoration with Au nanoparticles. The enhancement of the quantum detection efficiency originated from the surface plasmon resonance enhancement from the Au nanoparticles on the surface of the active area of the MPPC. Meanwhile the photon-number-resolving capability was well reserved. It is a proven technology by using metallic nanoparticles integrated with photodiodes to enhance photocurrent. Our results demonstrated that this technology could be further applied to single-photon detection. It provides a promising method for the design and fabrication of high-efficiency photon-number-resolving detectors with nanotechnique.

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