

Superconducting Nano/Microstrip Single Photon Detectors: from device fabrication to quantum applications

In the last decades the advancing of quantum information science concerning quantum computation, quantum communication and sensing has largely pushed the development of single-photon detectors (SPDs). Conventional semiconducting SPDs, such as photomultipliers and avalanche photodiodes, are successfully used for visible light detection but their performance drastically worsens in detecting near-infrared photons. Conversely, superconducting materials with an energy gap of a few meV, could allow to detect single photons with high efficiency in a wide range of wavelengths, from ultraviolet to mid-infrared range [1]. From 2001 [2] significant developments in SNSPDs technology produced detectors characterized by >95% detection efficiency DE (the probability of detecting a single photon), picosecond time resolution, milli-Hertz dark count rates DCR (false detecting events) and nanosecond recovery time [1, 3]. High-performance commercial products based on NbN or NbTiN SNSPDs in customized cryostats are now available both for quantum and interdisciplinary technologies for operation up to 1550 nm wavelengths where they outperform semiconducting materials. However, many challenges are still open to optimize the performance of these devices for specific applications such as the large area coverage. Superconducting microstrip single photon detectors (SMSPDs) are increasingly attracting the interest of the scientific community as a new platform for large area detectors with unprecedented advantaged in terms of fabrication. Moreover, there is an increasing demand of devices capable of detecting low-energy photons, as in free space communications, due to a reduced solar background, or space-ground integrated quantum network. The research activity regarding the impact of SNSPDs and SMSPDs in various applications including Quantum Key Distribution [4,5] is presented.

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