Detecting and understanding COVID-19 at an early-stage: Microrobot assisted SERS based platform

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Contributors:

IIT Bhilai : Dr. Dhruv Pratap Singh, Dr. Sesha Vempati, Dr. Raghavender Medishetty

AIIMS Raipur : Dr. Sanjay Singh Negi, Mr. Kuldeep Sharma

Abstract:

COVID19 poses a real threat to humans and is still spreading at an alarming rate across the globe. To date, it has covered over 200 countries with more than 6,30,000 confirmed cases and 30,000 deaths.1,2 The current scenario demands a rapid and accurate detection of COVID19 even at low concentrations. Most importantly, this early detection enables us in implementing the necessary measures to stop their growth at the early stage. Traditional detection methods such as polymerase chain reaction (PCR), lateral flow assay, cell culture etc. are of course quite sensitive and accurate, however, needing complex and time consuming procedures, which range from a few hours to a couple of days.3–6 This certainly impedes the timely detection of this fast spreading viral infection. Furthermore, these techniques provide a very little or no information about the intrinsic characteristics of the virus to develop any therapeutic methods.

The aim of this proposal is twofold: (i) rapid and reliable detection of COVID- 19 in the early stage, (ii) fundamental characterization of COVID-19 under different, controlled environments using optical imaging and spectroscopic mapping. In other words, along with the design of simplistic and rapid diagnosis methods, structural and mechanistic information of COVID-19 virus will be evaluated for the development of novel therapeutic methods. The basic idea is to develop a microfluidic chip that can unambiguously and quickly detect the COVID19 virus even at sparse concentrations. Antibody (IgG/IgM) functionalized microrobots will be designed and synthesized which can swim autogenously throughout the given fluid-sample and capture the virus, COVID-19. Once the microrobots are loaded with viruses, they will be collected in a small optical detection chamber from the fluid. This chamber is equipped with optical and spectroscopic mapping techniques that reveal the spectral fingerprint and hence the identity of the COVID19. Most of this diagnosis can be performed under minimal human interface or auto sampler/ remote access. Indeed this whole methodology can be extended to other viruses and bacteria where quick and accurate identification is demanding.

The proposed technique will be highly sustainable and affordable to provide diagnosis at very low cost, with a possible advancement of remote access diagnosis. Hence, we strongly believe that the proposal perfectly matches with the scope of the present call which includes development of diagnosis and therapeutic methods for COVID-19. Since we develop an indigenous technology in the state of Chhattisgarh, the technological, scientific and social impact is immense.