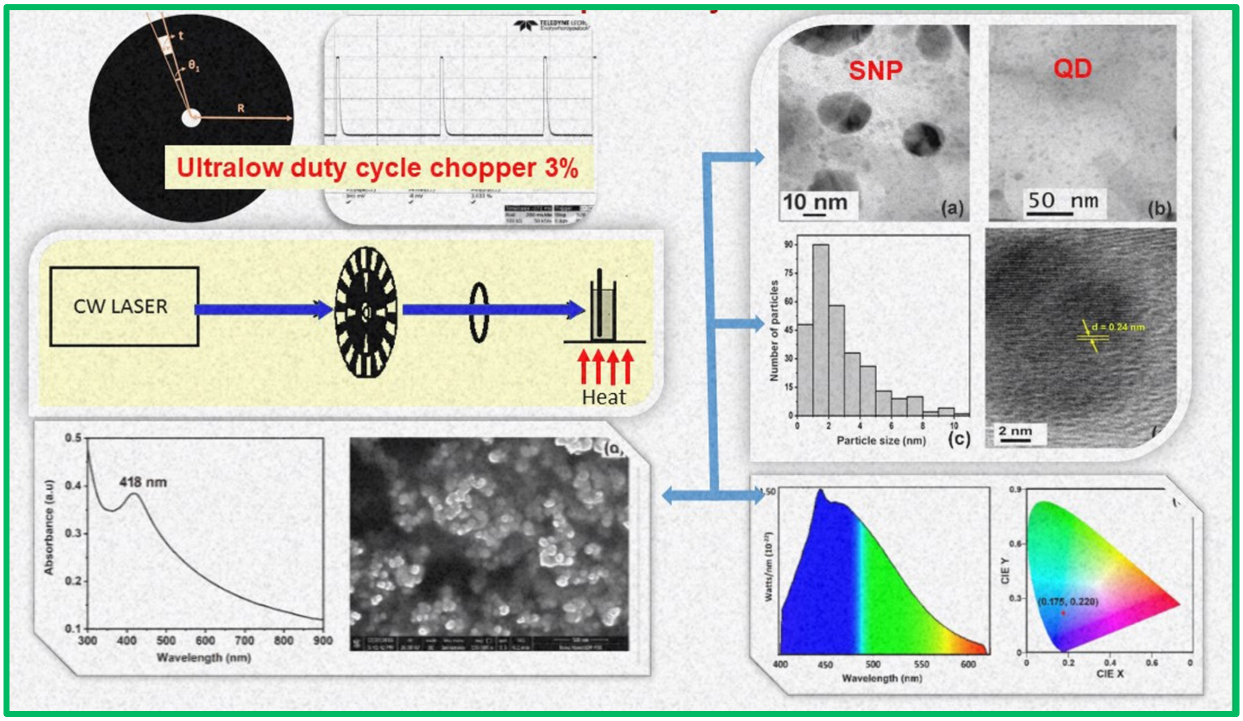
TRANSLATIONAL RESEARCH & INNOVATION CENTRE (TRIC-KU)
UNIVERSITY OF KERALA
(Office established in 2023)

Application for calling for “Expression of interest” for technology transfer by TRIC-KU University of Kerala

1. Name of the inventor(s): Sankararaman Sankaranarayana Iyer, Swapna Mohanachandran Nair Sindhu, Ashik Abdul Rahim Sajeela Beevi, Krishnanunni Ramachandran Nair Amba Devi, Vadakkedathu Parameswaran Narayanan Nampoori
2. Abstract of the invention (100-200 words):
   Laser assisted nanoparticle synthesis has become an important technique in recent years because of its simplicity of controlled processing and handling. Variety of Metal nanoparticles are extensively synthesized and used due to their physical and chemical properties and a wide range of applications in day to day life. So far, pulsed lasers of different wavelength and pulse width in a range of nano-second to femto-second and of high power density of 10^6 to 10^{14} W/cm^2 or high power continuous wave (cw) laser of 200 W to 1000 W of power density 10^6 W/cm^2 have been used for the synthesis of nanoparticles. In the present work we report for the first time a method of synthesizing metal nanoparticles with a low power cw laser of power density less than 10 W/cm^2. Here, the total energy needed for the ejection of nanoparticles from the metal target is provided as a combination of optical, thermal and mechanical energies. The laser is allowed to strike the metal target at regular intervals with the help of an electromechanical chopper. By varying the chopping frequency and the duty cycle, the size of the particle can be changed. In this work we have used silver as the metal target and water as the liquid medium. The nanoparticles produced are characterized by various techniques. Highly stable SNPs are obtained when glucose is also added in double distilled water.

3. Graphical representation of the invention:



4. Which country is most likely to benefit from your invention: World-wide
5. Publications

i. Ultralow duty cycle chopper instigated low power continuous wave laser assisted synthesis of silver nanoparticles: A novel approach, M S Swapna, A S Ashik, R A Krishnanunni, V P N Nampoori, S Sankararaman, Journal of Laser Applications, 32, 042017 (2020), doi: 10.2351/7.0000215 (IF: 2.521).

ii. Low power CW laser-assisted synthesis of plasmonic aluminium nanoparticles using low duty cycle optical chopper, M S Swapna and S Sankararaman, Canadian Journal of Physics, 100(3) (2022) 10.1139/cjp-2021-0042 (IF: 1.358).

Why laser-assisted synthesis?

Laser-assisted synthesis holds significant importance across various fields, particularly in nanotechnology, materials science, and biomedical engineering. This technique offers precise control over the synthesis of nanomaterials, enabling the production of nanoparticles with tailored properties such as size, shape, and composition. The ability to manipulate these parameters is crucial for optimizing the performance of nanomaterials in diverse applications, including catalysis, sensing, drug delivery, and tissue engineering. Laser-assisted synthesis also facilitates the synthesis of complex nanostructures that may be challenging to produce using conventional methods. Moreover, this approach often allows for rapid and efficient synthesis processes, reducing the time and energy required for manufacturing nanomaterials.

Fields where the invention finds application

(i) Ayurvedic pharmaceuticals

In Ayurveda, metal nanoparticles, often prepared as Bhasma formulations through complex purification and calcination processes, have been utilized for their purported therapeutic properties for centuries. These nanoparticles, derived from metals like gold, silver, copper, iron, and mercury, are believed to possess specific medicinal properties, with gold thought to rejuvenate and modulate immunity, and silver presumed to exhibit antimicrobial effects. However, concerns regarding their safety and toxicity persist, particularly with metals like mercury, prompting calls for careful preparation and administration under the guidance of qualified Ayurvedic practitioners.

(ii) Industrial Application

Metal nanoparticles find a myriad of industrial applications owing to their unique properties. In catalysis, they serve as highly efficient and selective catalysts due to their large surface area-to-volume ratio and enhanced reactivity, facilitating processes such as hydrogenation, oxidation, and pollutant degradation in environmental remediation.

(iii) Electronic industry

Additionally, in electronics, metal nanoparticles are integral components in conductive inks, coatings, and printable electronics, offering superior conductivity and flexibility for applications in flexible displays, RFID tags, and solar cells.

(iv) Health care sector

In the healthcare sector, metal nanoparticles are utilized in diagnostics, drug delivery systems, and therapeutic agents, capitalizing on their biocompatibility, surface plasmon resonance, and targeting capabilities for precision medicine and cancer treatment.

WE CLAIM:

1. A system [100] for synthesis of metal nanoparticles, consisting of:

a laser source [101];

a electromechanical chopper [102];

a lens [103];

a target metal [104];

a liquid medium [106]; and

a heat source [107],

wherein the He-Cd laser source [101] generates low power continuous wave laser beam [110] of power density 7.5W/ cm^2,

wherein the lens [103] is placed in the path of the laser beam [110] to pass through the centre of the lens [103] to the target metal [104],

wherein the target metal [104] is placed at the focal plane of the lens [103], disposed in a liquid medium [106] and maintained at a temperature range between 40°C and 60°C via heat source [107],

wherein the target metal [104] generates nanoparticles when the laser beam [110] is irradiated on the target metal [104] surface,

wherein the irradiation time of the laser beam [110] on the target metal [104] range from 1 hour to 3 hours, and

wherein the duty cycle of the light pulse of the laser irradiating from the electromechanical chopper [102] to generate the metal nanoparticles range between 3% and 5% at a frequency range between 1Hz and 5 Hz.

2. The system [100] for synthesis of metal nanoparticles as claimed in claim 1, wherein the target metal [104] comprises of metals or metal alloys selected from silver, gold and palladium.

3. The system [100] for synthesis of metal nanoparticles as claimed in claim 1, wherein the average size of the metal nano particles ranges between 1nm and 50 nm.

4. The system [100] for synthesis of metal nanoparticles as claimed in claim 1, wherein the liquid medium [106] comprises of water or an aqueous solvent and a stabilizing agent.

5. The system [100] for synthesis of metal nanoparticles as claimed in claim 4, wherein the stabilizing agent is selected from one of glucose, starch, polysaccharides and combinations thereof.

6. The system [100] for synthesis of metal nanoparticles as claimed in claim 1, wherein the focal length of the lens [103] is corrected for the refractive index of the liquid medium [106].

7. A laser assisted method [300] for synthesis of metal nanoparticles, comprising of steps:

generating [201] a continuous wave laser beam [110] from a laser source [101];

passing [202] the laser beam [110] through a electromechanical chopper [102] followed by a lens [103] to focus on a target metal [104];

rotating [203] a electromechanical chopper [102] to convert the continuous wave laser beam [110] to intensity modulated laser beam;

focusing [204] the generated intensity modulated laser beam through a lens [103] to the target metal [104]; and

irradiating [205] a target metal [104] disposed in a liquid medium [106] with the laser beam [110] to yield the metal nanoparticles,

wherein the duration of irradiation ranges from1 hour to 3 hours,

wherein the target metal [104] is maintained at a temperature range between 40°C and 60°C using a heat source [107],

wherein the continuous wave laser beam [110] is a He-Cd laser of wavelength 442 nm and power of 60 mW, and

wherein the duty cycle of the laser beam [110] emanating from the electromechanical chopper [102] range between 3% and 5% at a frequency range between 1Hz and 5 Hz.

8. The laser assisted method [300] for synthesis of metal nanoparticles [200] as claimed in claim 7, wherein the size of the metal nano particles is varied by changing the frequency of rotation of the electromechanical chopper [102] and the duty cycle of the laser beam [110].

Dated this 19th day of July 2019

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Agent for Applicant

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