CLAIMS

1. A system (100) for identifying and authenticating a tag (101) applied to an object, wherein the tag (101) is defined by at least one luminescent spatial pattern and one spectral signature of luminescent particles contained in said tag (101) and defining said spatial pattern, the system comprising:

a reading module (110) to acquire the tag information, said reading module (110) comprising:

a lighting unit (114) comprising a light source operated in a pulse-mode, said light source being adapted to illuminate the tag with excitation light so as to excite the particles of the tag (101), thus resulting in the emission of the luminescent spatial pattern by the tag (101),

an imaging unit (111) adapted to record an image of said spatial pattern,

a spectral unit (112) adapted to record the spectrum of said spectral signature,

a timing control unit (115) adapted to synchronize the actions of the other units of the reading module (110),

a processing module (120) both in communication with the reading module (110) and with a database (130) containing the spatial patterns and spectral signatures of predetermined tags, said processing module (120) comprising:

a decoding unit (121) adapted to decode the image recorded by the imaging unit (111), provide a serial number corresponding to said image and compare said serial number with the corresponding serial numbers of the predetermined tags so as to identify the tag (101), and

a validation unit (122) adapted to compare the spectrum recorded by the spectral unit (112) with the spectra of the predetermined tags so as to authenticate the tag (101),

characterised in that the imaging unit (111) and the spectral unit (112) record the respective image and spectrum in a sequential manner, their acquisition being synchronized with different excitation light pulses.

2. The system (100) according to claim 1, wherein a first and a second excitation light pulses are used.

3. The system (100) according to ~~any one of~~ claim 1 or 2, wherein the acquisition of the imaging unit (111) is synchronized with the first excitation light pulse and the acquisition of the spectral unit (112) is synchronized with the second pulse.

4. The system (100) according to any preceding claim, wherein the imaging unit (111) records a signal image and a background image and the spectral unit (112) records a signal spectrum and background spectrum.

5. The system (100) according to claim 4, wherein the decoding unit performs the identification of the tag using the image resulting from the subtraction of the background image from the signal image and the spectral unit performs the validation of the tag using the spectrum resulting from the subtraction of the background spectrum from the signal spectrum.

6. The system (100) according to any preceding claim, further comprising a global positioning unit (113) and a localization unit (123).

7. A tag (101) applied to an object, comprising a plurality of dots, each dot comprising one or more luminescent materials, the plurality of dots defining a luminescent spatial pattern and a spectral signature, wherein one or more of said plurality of dots comprise at least one luminescent material different from at least one luminescent material in one or more of other of said plurality of dots, the different luminescent materials emitting different spectra, whereby the tag defines a code comprising a plurality of values greater than binary values.

8. A method for identifying and authenticating a tag (101) applied to an object, wherein the tag (101) is defined by at least one luminescent spatial pattern and one spectral signature of luminescent particles contained in said tag (101) and defining said spatial pattern, comprising the steps of :
   - illuminating the tag (101) with excitation light emitted by a light source operated in a pulse-mode so as to excite the luminescent particles of the tag (101), thus resulting in the emission of the luminescent spatial pattern by the tag (101)
   - recording with an imaging unit (111) of an image of said spatial pattern,
   - recording with a spectral unit (112) of a spectrum of said spectral signature,
   - decoding with a decoding unit (121) of said image so as to identify the tag (101) (101),
   - validating with a validation unit (122) of said spectrum so as to authenticate the tag (101),

   characterised in that the imaging unit (111) and the spectral unit (112) record their respective data in a sequential manner, their acquisition being synchronized with different excitation light pulses.

9. The method according to claim ~~6~~8, wherein a first and a second excitation light pulses are used.

10. The method according to ~~any one of~~ claim~~s 6 or 7~~ 9, wherein the acquisition of the imaging unit (111) is synchronized with the first excitation light pulse and the acquisition of the spectral unit (112) is synchronized with the second excitation light pulse.

11. The method according to any one of claims ~~6~~8-10, wherein the imaging unit (111) records a signal image and a background image and the spectral unit (112) records a signal spectrum and background spectrum.

12. The method according to claim ~~10~~11, wherein the decoding unit performs the identification of the tag using the image resulting from the subtraction of the background image from the signal image and the spectral unit performs the validation of the tag using the spectrum resulting from the subtraction of the background spectrum from the signal spectrum.

13. The method according to any one of claims ~~7~~8-12, further comprising a step of determining the exact position of the tag.

14. A method for identifying and authenticating a tag (101) applied to an object, wherein the tag (101) is defined by at least one luminescent spatial pattern and one spectral signature of luminescent particles contained in said tag (101) and defining said spatial pattern, comprising the steps of :
    - illuminating the tag (101) with excitation light emitted by a light source operated in a pulse-mode so as to excite the luminescent particles of the tag (101), thus resulting in the emission of the luminescent spatial pattern by the tag (101)
    - recording with an imaging unit (111) of a signal image and a background image of said spatial pattern,
    - subtracting the background image from the signal image so as to determine an image of said spatial pattern,
    - recording with a spectral unit (112) of a signal spectrum and a background spectrum, of said spectral signature,
    - subtracting the background spectrum from the signal spectrum so as to determine a spectrum of said spectral signature,
    - decoding with a decoding unit (121) of said images, so as to identify the tag (101), and
    - validating with a validation unit (122) of said image and the spectrum, by
    - decomposing said image into different colour components and comparing the intensity ratios between said colour components with the information stored in the database (130), and
    - comparing said spectrum to the spectra stored in the database.

15. The method according to claim ~~13~~14, wherein the decoding unit (121) performs a pre-validation step consisting in checking the presence of the spatial pattern on the image resulting from the subtraction of the background image from the signal image.

16. The method according to claim ~~13 or 14~~14 or 15, wherein the validation unit (121) performs a first validation level using the information recorded by the imaging unit by decomposing the image of the tag into three colour components and analysing their ratios.

17. The method according to claim 16, wherein the validation unit (121) performs a second and third validation levels using the information recorded by the spectral unit by analysing the peak intensities at certain wavelengths and the ratios between these values.

18. The method according to any one of claims ~~13 to 17~~14-17, wherein the validation unit (122) performs a further step of calculating the fluorescence lifetime of the particles.

19. A system (100) for identifying and authenticating a tag (101) applied to an object, wherein the tag (101) is defined by at least one luminescent spatial pattern and one spectral signature of optically active nanoparticles contained in said tag (101) and defining said spatial pattern, the system comprising:

optically active nanoparticles contained in said tag (101) and defining said spatial pattern, comprising the steps of :

- illuminating the tag (101) with infrared excitation light emitted by a light source driven in a pulse-mode so as to excite the nanoparticles of the tag (101), thus resulting in the emission of the luminescent spatial pattern by the tag (101)
- recording with an imaging unit (111) of an image of said spatial pattern,
- recording with a spectral unit (112) of a spectrum of said spectral signature,
- decoding with a decoding unit (121) of said image so as to identify the tag (101) (101),
- validating with a validation unit (122) of said spectrum so as to authenticate the tag (101),

characterised in that the imaging unit (111) and the spectral unit (112) record their respective data in a sequential manner, their acquisition being synchronized with different excitation light pulses.

26. The method according to claim 25, wherein a first and a second excitation light pulses are used.

27. The method according to ~~any one of~~ claims 25 or 26, wherein the acquisition of the imaging unit (111) is synchronized with the first excitation light pulse and the acquisition of the spectral unit (112) is synchronized with the second excitation light pulse.

28. The method according to claims 25, wherein the imaging unit (111) records a signal image and a background image and the spectral unit (112) records a signal spectrum and background spectrum.

29. The method according to claim 28, wherein the decoding unit performs the identification of the tag using the image resulting from the subtraction of the background image from the signal image and the spectral unit performs the validation of the tag using the spectrum resulting from the subtraction of the background spectrum from the signal spectrum.

30. The method according to claim 25, further comprising a step of determining the exact position of the tag.

31. A method for identifying and authenticating a tag (101) applied to an object, wherein the tag (101) is defined by at least one luminescent spatial pattern and the one spectral signature of optically active nanoparticles contained in said tag (101) and defining said spatial pattern, comprising the steps of :

- illuminating the tag (101) with an infrared excitation light emitted by a light source driven in a pulse-mode so as to excite the nanoparticles of the tag (101), thus resulting in the emission of the luminescent spatial pattern by the tag (101)
- recording with an imaging unit (111) of a signal image and a background image of said spatial pattern,
- subtracting the background image to the signal image so as to determine an image of said spatial pattern,

- recording with a spectral unit (112) of a signal spectrum and a background spectrum, of said spectral signature,
- subtracting the background spectrum from the signal spectrum so as to determine a spectrum of said spectral signature,
- decoding with a decoding unit (121) of said images, so as to identify the tag (101), and
- validating with a validation unit (122) of said image and the spectrum, by
- decomposing said image into different colour components and comparing the intensity ratios between said colour components with the information stored in the database (130), and
- comparing said spectrum to the spectra stored in the database.

32. The method according to claim 31, wherein the decoding unit (121) performs a pre-validation step consisting in checking the presence of the spatial pattern on the image resulting from the subtraction of the background image from the signal image.

33. The method according to ~~any one of~~ claims 31 or 32, wherein the validation unit (122) performs a further step of calculating the fluorescence lifetime of the nanoparticles.