

MagStrep® Strep-Tactin® bead-based protein purification

Fast purification of Strep-tag®II and Twin-Strep-tag® fusion proteins in reaction tubes with high purity

1. Description

MagStrep® Strep-Tactin® beads are ferrimagnetic spheres covered with 6% agarose and coupled with Strep-Tactin® allowing efficient immobilization and purification of Strep-tag®II as well as Twin-Strep-tag® fusion proteins. The magnetic core is used to easily separate the beads from the surrounding liquid with the help of a magnet, making MagStrep® Strep-Tactin® beads perfectly suitable for batch purifications. Due to the agarose surface and the high specificity of Strep-Tactin®, the beads show a very low non-specific protein binding.

This protocol describes the application of MagStrep® Strep-Tactin® beads for batch purification in reaction tubes.

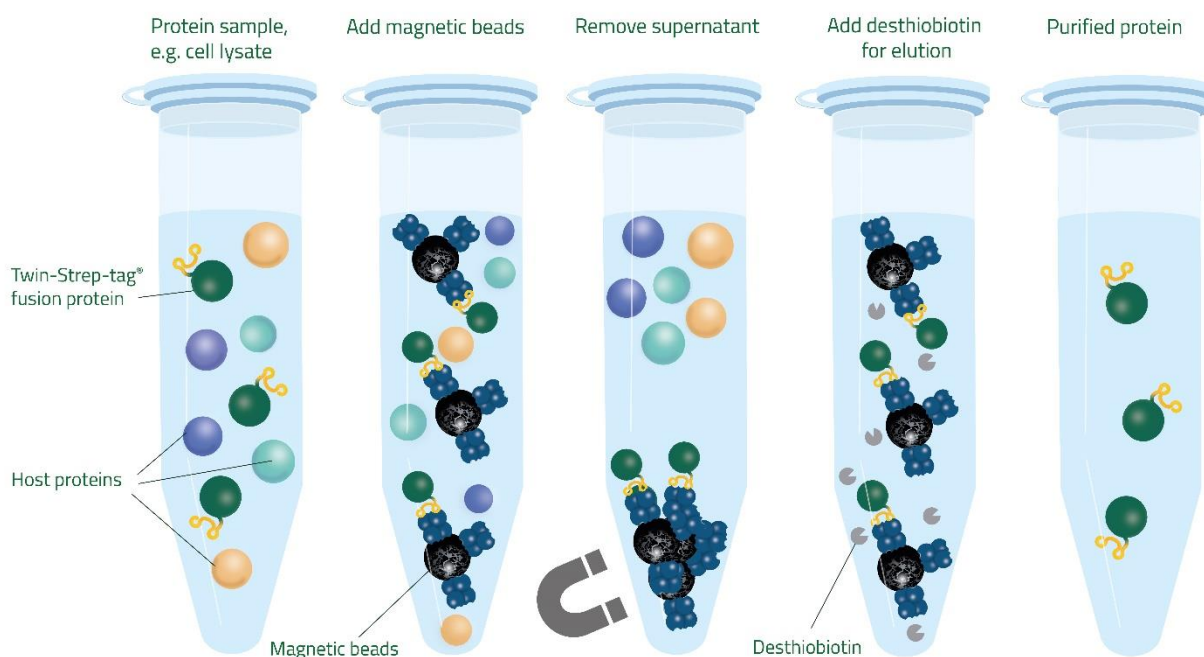


Figure 1: Workflow of protein purification with MagStrep® Strep-Tactin® beads

2. Required material and recommendations

The table below lists all required buffers provided by Cube Biotech for protein purification with MagStrep® Strep-Tactin® beads (Cat. No. 2-1613-xxx). Please note that the wash buffer is provided as 10-fold concentrated solution. Prior to application, the buffer has to be diluted to obtain single concentrated buffer. To achieve this, mix one part of 10-fold concentrated buffer with nine parts of deionized water.

Buffers/solutions		Cat. No.	Quantity
Wash buffer	Buffer W (10 x) (1 M Tris-HCl, 1.5 M NaCl, 10 mM EDTA, pH 8)	2-1003-100	100 mL
Elution buffer	100 mM Tris-HCl, 150 mM NaCl, 1 mM EDTA, 10 mM desthiobiotin, pH 8)	Not provided. Prepare freshly.	
Regeneration buffer	100 mM NaOH (working concentration)	Not provided. Prepare freshly.	

The composition of all purification buffers can be modified to suit the properties of the target protein. A list with compatible reagents is available at <https://www.iba-lifesciences.com/downloadcenter/>. Please note that the magnetic beads are stable at pH 6-10.

For fast and simple separation of magnetic beads from buffer or sample, we recommend the application of our Magnetic Separator (Cat. No. 2-1602-000) if the protein purification is performed in reaction tubes (1.5-2 mL). With the Magnetic Separator, up to 24 samples can be processed in parallel. If a larger number of samples should be purified, we recommend the use of round-bottom 96-well plates and an appropriate magnetic device.

Using the Twin-Strep-tag® leads to higher yields compared to Strep-tag®II fusion proteins, due to the higher binding affinity to Strep-Tactin®.

MagStrep® Strep-Tactin® beads can bind by free biotin for example in cell culture supernatants. This bond is nearly irreversible and prevents binding of the Strep-tag®II and Twin Strep tag® fusion protein and does not allow regeneration of the magnetic beads (in contrast to bound desthiobiotin). Therefore, it has to be removed or masked prior to purification. The best and simplest precaution is to add stoichiometric amounts of avidin or BioLock for irreversible masking prior to protein purification. Other solutions are removal via dialysis, ammonium sulfate precipitation or cross-flow filtration/concentration. In addition, the co-purification of biotinylated proteins is possible. Biotinylated proteins are only present in the cell in very small amounts, but if a highly pure target protein for analytic applications like mass spectrometry is required, co-purification of biotinylated proteins can be avoided by application of BioLock containing avidin. Avidin specifically masks biotinylated proteins without influencing the binding properties of the Twin-Strep-tag® or Strep-tag®II.

The protocol for masking free biotin and biotinylated proteins is provided at <https://www.iba-lifesciences.com/downloadcenter/>.

You can adjust the volume of magnetic beads according to your target protein concentration. For proteins >90 kDa, optimal binding might not be reached under the described conditions. More information on how to improve your protein yield can be found in section 4.

3. Protocol

3.1. Batch purification in reaction tubes



- This protocol is optimized for working at room temperature.
- 20 µL of the 5 % suspension contain 1 µL magnetic beads.
- The binding capacity of the magnetic beads is 14 µg/µL (0.28 nmol of a 50 kDa protein)
- The volume of the cleared extract should not exceed 2.5 mL per µL MagStrep® Strep-Tactin® beads.

- 3.1.1.** Resuspend the magnetic beads by pipetting up and down. For **250 µL sample**, pipette **100 µL of the 5 % suspension** (5 µL beads) into a reaction tube, place it on the magnetic separator to separate the beads and remove the supernatant.
- 3.1.2.** Equilibrate beads in **500 µL 1x Buffer W**. Separate the beads in the magnetic separator and remove the supernatant. Repeat this step two times.
- 3.1.3.** Resuspend the magnetic beads with the **250 µL sample** containing the target protein. Incubate for **10 minutes**. Keep the beads in suspension by inverting the tube occasionally, or by placing the tube on a roller.
- 3.1.4.** Place the reaction tube in the magnetic separator and carefully remove the supernatant.
- 3.1.5.** Remove tube from the magnet and add **500 µL 1x Buffer W**. Resuspend carefully and place the reaction tube in the magnetic separator to collect the beads. Remove the supernatant and repeat this step two times.
- 3.1.6.** Elution can occur under native (a) or denaturing (b) conditions. Elution under native conditions offers specific elution conditions and thereby higher protein purity.
- a) **Native elution:** Remove the reaction tube from the magnetic separator, resuspend with **125 µL Elution Buffer** and incubate for **10 minutes**. Place the reaction tube in the magnetic separator and transfer the supernatant containing the target protein into a new reaction tube. Repeat this step once for higher recovery. The first elution step will yield the target protein at the highest concentration.
- b) **Denaturing elution:** Apply conventional SDS-PAGE sample buffer and heat the sample to **95 °C** for **2 minutes**. Immobilized Strep-Tactin® will denature under these conditions and detach from the magnetic beads, leading to an additional band at 13.5 kDa during SDS-PAGE analysis. Strep-Tactin® magnetic beads exhibit very low non-specific protein binding activity so that no substantial amounts of other contaminating proteins should be detectable.

3.2. Magnetic bead regeneration (optional)



Please note that the regeneration in batch may be incomplete if done incorrectly. After an incomplete regeneration, proteins from the first purification may remain on the magnetic beads and can be co-purified as an impurity once another protein is purified using the same beads. Especially in applications like pull-down assays or co-immunoprecipitations, remaining proteins could lead to false-positive hits. Therefore, we do not recommend using the regenerated magnetic beads for the purification of a different protein than the one they were originally used for.

- 3.2.1.** Freshly prepare the regeneration buffer (100 mM NaOH) before use.
- 3.2.2.** Add **100 µL of regeneration buffer per 1 µL of magnetic beads**. Incubate for **2 minutes** at room temperature.
Place the beads in a magnetic separator to separate them. Remove the supernatant.
- 3.2.3.** Equilibrate beads in 100 µL 1x Buffer W per 1 µL beads. Separate the beads in the magnetic separator and remove the supernatant. Repeat this step two times.
- 3.2.4.** Store the beads in **1x Buffer W** at **2-8 °C**.

4. Optimization

Starting from the standard protocol described in section 3, binding efficiency can be optimized for each individual protein.

- If the protein concentration in the sample is known, adjust the bead volume accordingly. For optimal yield, the total bead binding capacity should be around 5 times the total amount of protein. For example, if the total amount of a 50 kDa protein is 28 µg, which theoretically could be bound by 2 µL of beads, add 5x 2 µL = 10 µL beads and incubate for 10 minutes to achieve the best yield.
- Samples with a low protein concentration should be concentrated before use, or a smaller bead volume should be added. The minimum recommended target protein concentration is 1 pmol/µL (50 ng/µL of a 50 kDa protein).
- For large proteins >90 kDa, the binding capacity may decline. To improve the yield of large proteins, increase the bead volume.

For more detailed information please visit <https://www.iba-lifesciences.com/applications/protein-purification/magnetic-beads-purification/>

5. Troubleshooting

No or weak binding to MagStrep® Strep-Tactin® beads

Strep-tag®II or Twin-Strep-tag® is not present.	Add protease inhibitors during cell lysis and work quickly at 2-8 °C. If <i>E. coli</i> is used as expression host, use a protease deficient expression strain.
Strep-tag®II or Twin-Strep-tag® is not accessible.	Fuse the tag with the other protein terminus, use a different linker, or exchange the Strep-tag®II by Twin-Strep-tag®.
Strep-tag®II or Twin-Strep-tag® has been degraded.	Check if the tag is associated with a portion of the protein that is processed. If it is the case, change the position of the tag.
Strep-tag®II or Twin-Strep-tag® is partially accessible.	Reduce washing volume.

Contaminating proteins

Contaminants are short forms of the tagged protein.	Use protease deficient <i>E. coli</i> expression strains. Add protease inhibitors after cell lysis. Fuse Strep-tag®II with the other protein terminus. Check if internal translation initiation starts (only in case of C- terminal tag) or premature termination sites (only in case of N-terminal tag) are present. Add another tag to the other terminus and use both tags for purification.
Contaminants are covalently linked to the recombinant protein via disulfide bonds.	Add reducing reagents to all buffers. A list with compatible reagents can be downloaded at https://www.iba-lifesciences.com/downloadcenter/ .
Contaminants are non-covalently linked to the recombinant protein.	Increase the ionic strength of all buffers (up to 5 M NaCl) or add mild detergents (up to 2 % Triton X-100, 2 % Tween 20, 0.1 % CHAPS, etc.). A list with compatible reagents can be downloaded at https://www.iba-lifesciences.com/downloadcenter/ .
Contaminants are biotinylated proteins.	Add BioLock (biotin blocking solution) or avidin. A detailed protocol for biotin blocking can be downloaded at https://www.iba-lifesciences.com/downloadcenter/ .

Inefficient elution

Proteins remain bound to magnetic beads	Use 50 mM biotin (Buffer BXT) for elution. Please note that MagStrep® Strep-Tactin® beads are not reusable after elution with biotin.
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